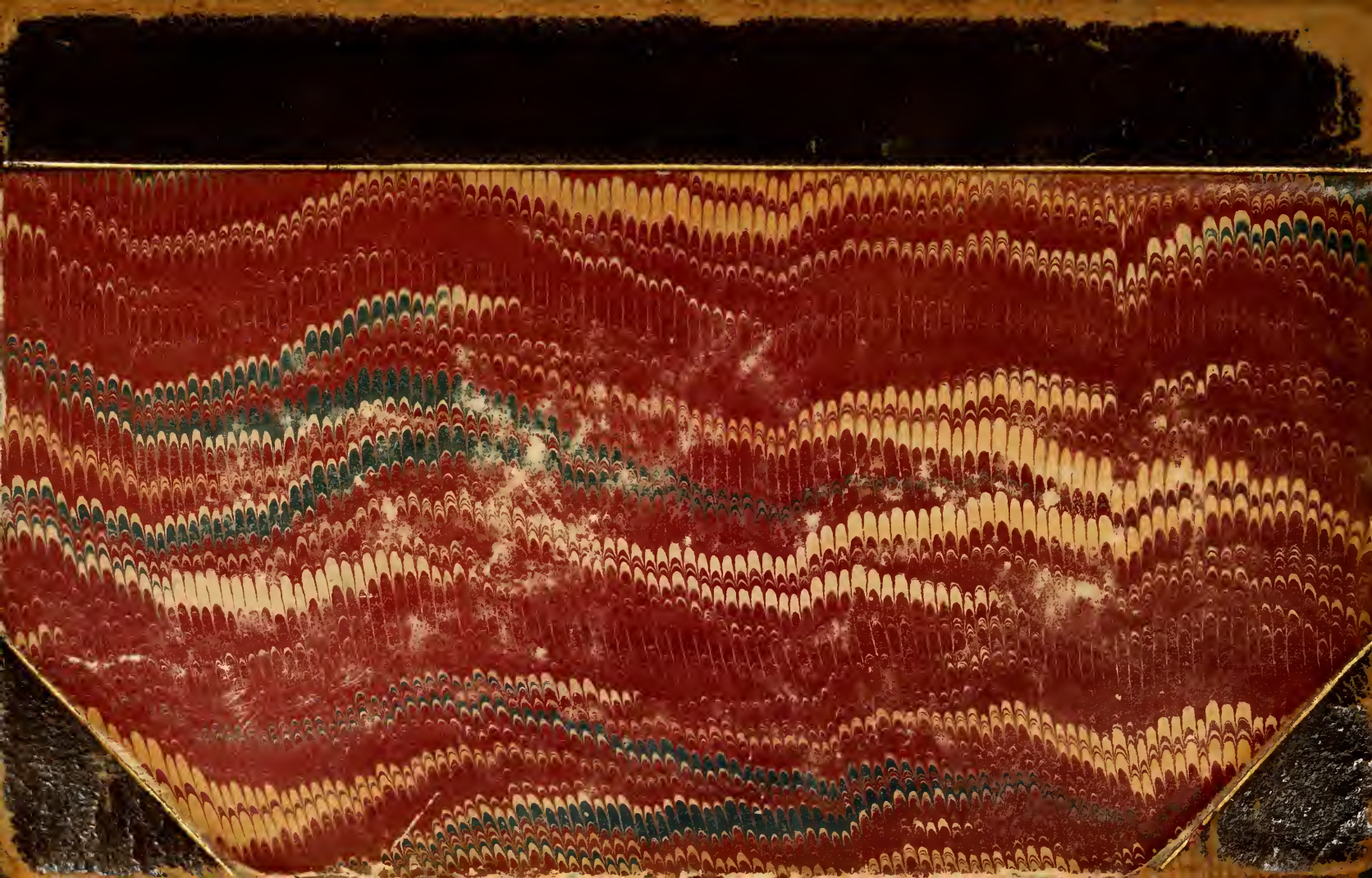

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On Microscopic Sublimates; *and especially on the* Sublimates *of the* Alkaloids. By William A. Guy, M.B., F.R.C.P., F.R.S., Professor of Forensic Medicine, King's College, &c. &c.

(Read Oct. 9, 1867.)

The paper which I submit to the Society this evening has for its object to extend and strengthen the union which already exists between micro-chemistry and the microscope. I wish to show that, by a very simple chemical operation, we may obtain a vast number of new microscopic objects; and that by the application to them of a few chemical reagents, of which the immediate and remote effects must also be studied under the microscope, the number of such objects may be almost indefinitely increased. Let me add that this subject, if I am not greatly mistaken, will be found to commend itself to the Society by combining in an unusual degree the claims of novelty, largeness of scope, and practical utility. I will offer a few remarks under these three heads.

1. *Novelty.*—The history of this subject dates from the year 1858, when I proposed to substitute for the reduction-tube in common use a short specimen tube, closed above by a flat disk of glass, and, in certain cases, a slab of white porcelain, a ring of metal or glass, and the same glass disk. The heat of a spirit lamp was to be applied to the tube or slab, and the vapour of the object under examination was to be received on the disk. This simple method was first applied to arsenious acid and the metal arsenic, and bore as its first fruits the analysis of the arsenic crust, and the discovery that metallic arsenic is deposited from its vapour in the form of globules; and that the crystals of arsenious acid assume forms not previously described, among which the tetrahedron is not to be found. The new method was recommended, and these facts recorded, in 'Beale's Archives of

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Medicine' (No. iii, 1858), and in a paper read at a meeting of this Society, and published in your Journal, in 1861. At that time, and till within a few months of this date, I limited the application of this method of procedure to the volatile metals, mercury, arsenic, cadmium, selenium, tellurium, and some of their salts, and to a few other volatile matters, such as the muriate of ammonia, camphor, and sulphur. It was no part of my plan to test these sublimates by reagents; and the use of the microscope was restricted to the examination of the sublimates themselves. But in the year 1864, Dr. Helwig, of Mayence, made the unexpected discovery that the alkaloids when submitted to this treatment could be made to yield sublimates; and in 1865, he published a work under the title of "The Microscope in Toxicology,"* in which the sublimates of the alkaloids and their reactions are minutely described, and largely illustrated by photo-micrographs. This work I have recently made the subject of serious study; and in verifying its statements, have been led to transgress its limits, and have found that the method of procedure first suggested for such mineral substances as arsenic and mercury, and their salts, and then extended by Helwig to the alkaloids, strychnine, morphine, veratrine, &c., might be still further extended to such animal products as the constituents of the urine and the stains of blood, and indeed to all volatile and decomposable matters, whether of vegetable or of animal origin. A few specimens of sublimed alkaloids were shown, a few months ago, at a soirée of the Pharmaceutical Society, and a larger number, with sublimates of blood-stains, and choice specimens of arsenious acid and corrosive sublimate, at a subsequent meeting at the College of Physicians; while an account of several investigations bearing on the subject, which I have carried on during the last six months, has appeared in five successive numbers of the 'Pharmaceutical Journal.' Still, I believe myself justified in speaking of the whole subject of microscopic sublimates as novel, though no longer new.

2. *Largeness of scope.*—Heat, as applied by the flame of the spirit lamp to the reduction-tube or platinum foil, is one of the chemist's familiar tests and means of identifying arsenious acid and corrosive sublimate; and it has long supplied an element in the description of the alkaloids and other

* 'Das Mikroskop in der Toxikologie.' "Beiträge zur mikroskopischen und mikrochemischen Diagnostik der wichtigsten Metall—und Pflanzengifte, für Gerichtsärzte, gerichtliche Chemiker und Pharmaceuten, mit einem Atlas photographirter mikroskopischer Präparate," von Dr. A. Helwig, pract. Arzte und Grossherzoglich Hessischem Kreiswundarzte in Mainz. 1865.

analogous bodies. It is now proposed to apply this test of heat in such a way that not only shall the direct changes of form, colour, and position be noted, but the deposit from the vapour or smoke be collected and examined, and then submitted to the action of reagents. So that to the one test of heat the two important subsidiary tests of the microscopic character of the sublimate, and that of its reactions, are superadded, the three together constituting a compound test, or method of procedure, obviously admitting of most extensive application. Indeed, if we reflect on the number of distinct elements which a full description of the results of this compound test, as applied to a minute particle of any solid body, or to the deposit from a solution, must involve, it will be obvious that there are very few, if any, substances volatile or decomposable by heat, which by its means we should fail to identify. This result would be still more certain if we first submitted the substance to microscopic examination.

3. *Practical utility.*—To turn this simple method of procedure to practical account in chemistry and toxicology, three things are necessary. The results obtained should be characteristic; the quantities which yield them should be extremely small; and the method should admit of application, not only to the substance itself, but to the deposit from its solutions. All these conditions are fully satisfied, not only in the case of such simple matters as arsenious acid and corrosive sublimate, but also in the cases of the principal poisonous alkaloids, such as strychnine, morphine, and veratrine. I will illustrate these three conditions by instances in point.

As examples of characteristic changes of form due to the application of heat, I may instance the complete dispersion in white vapour of arsenious acid and corrosive sublimate; the change of colour, melting, fuming, and deposit of carbon, which mark the alkaloids as a class; the deposit of carbon and reduction of silver from the tartrate of silver; the explosion of the oxalate of silver; and the quick rosy discoloration of alloxan. As examples of characteristic sublimates, I may mention the brilliant octohedral crystals of arsenious acid, contrasted with the radiating and projecting groups of needles of corrosive sublimate; the jointed plates and prisms of cantharadine; the crossed twigs of solanine; the detached rhomboidal crystals of veratrine; and the compound crystals and radiating patterns of strychnine, morphine, cryptopia, &c. As examples of characteristic reactions I may specify that of morphine with distilled water, and with dilute hydrochloric acid; and those of strychnine with the solutions of bichromate of potash and carbazotic acid.

That the test of sublimation succeeds with very small quantities is sufficiently proved by the case of strychnine, of which I have shown that the $\frac{1}{100}$th of a grain will give fourteen successive sublimates (of these eleven were obtained prior to any change of form), and that one of the smallest of these yielded three characteristic secondary sublimates. So that sublimates may certainly be obtained consisting of as little as the $\frac{1}{5000}$th of a grain.*

That this mode of procedure is applicable to deposits from solutions equally with the substance dissolved I showed long since in the case of arsenious acid, and recently in that of strychnine, by procuring five well-marked sublimates in succession from a spot of the alkaloid containing the $\frac{1}{1000}$th of a grain deposited from its solution in æther. I have obtained similar results from a solution of strychnine in benzole, and from a solution of the acetate neutralized by the vapours of ammonia.

I have now said all that I deem necessary under the three heads of novelty, largeness of scope, and practical utility, and shall content myself, by way of preface, with repeating what I have said elsewhere of one variety of the sublimates of morphine, that "in the size and brilliancy of the crystals, and the rapidity of their formation, they surpass every chemical reaction of which I have had experience."† I speak of the reactions of the smoky sublimate of morphine with distilled water and one or two saline solutions; but words nearly as emphatic might be very justly used in speaking of some of the reactions of strychnine.

And now, having introduced my subject by these prefatory remarks, I am keenly alive to the embarrassment proverbially ascribed to a superabundance of materials. I find that I have already accumulated a store of new and curious microscopic objects, which I am naturally tempted to display, but am restrained by the fear that some at least of those objects may prove to be exceptional, and not typical, specimens. I have, therefore, determined to select, as the staple of this paper, the two alkaloids—strychnine and morphine, to describe and illustrate the leading varieties of their sublimates and some of their reactions, introducing other sublimates and their reactions only so far as may be required for the purpose of illustration. I will speak of strychnine first, and describe the results of an experiment made with this alkaloid when I had brought my paper to this point. I

* 'Pharmaceutical Journal,' July, 1867.
† Ibid., September, 1867.

placed the $\frac{1}{1000}$th of a grain of pure crystallized strychnine on a clean slab of white porcelain, in the centre of a glass ring about an eighth of an inch thick, and with an opening $\frac{7}{12}$ths of an inch wide. Over this ring I placed a disk of window glass, the size of a shilling, quite clean, and dried and warmed in the flame of the spirit-lamp. This simple apparatus I supported on the ring of a retort-holder, and placed before me at such a height that the glass disk was a little below the level of the eye, so that I could catch the reflection of the light from the surface of the disk, at the same time that I could see through the glass the changes taking place on the porcelain. I then applied a small flame of a spirit-lamp to the part of the slab bearing the strychnine, beginning with the point of the flame barely reaching the slab, and gradually approaching nearer and nearer, till I perceived a mist on the glass disk. As soon as this happened I withdrew the lamp, and found that a milk-white spot formed in the centre of the mist, and speedily enlarged, till it became a white circular stain about the sixth of an inch wide. As the mist settled on the glass, the strychnine was observed to darken.

After an interval of about a minute, I removed the disk, adjusted a second, and repeated the operation, with the same result, only that the white spot was larger and the strychnine darker. A third disk received a still larger sublimate, and the strychnine melted into a brown layer. The melted alkaloid, growing darker with each fresh operation, yielded six more well-marked sublimates, and was then reduced to a jet-black spot of carbon about the size of a split-pea. The seventh spot was the largest, and was formed by several small, white, circular spots, spreading and coalescing.

In this instance, then, a thousandth of a grain of crystallized strychnine yielded nine distinct sublimates in succession; and among these there must have been more than one weighing less than the $\frac{1}{10000}$th of a grain.

Of these nine sublimates I took the third in order, submitted it to the heat of the spirit-lamp, and obtained from it two distinct white sublimates, leaving on the disk itself a stain which was not removed by the further application of heat. Now, if I assume, what I think I am justified in doing, that this third sublimate did not weigh more than the $\frac{1}{5000}$th of a grain, the smaller of the two (for they were of unequal size) must have consisted of less than the $\frac{1}{10000}$th of a grain. I may add that from each of three or four successive $\frac{1}{10000}$ths of a grain (a quantity visible as a bright speck on a slab of black glass) I have obtained a single well-

marked sublimate of strychnine, and a single black speck of carbon, as a residue.

The same sublimate, with the same residue, may be obtained from strychnine in powder, and from strychnine as deposited from its solutions; but, in this last case, the alkaloid does not melt, though it leaves a speckled black stain.

I will now describe the sublimates of strychnine, with these ten sublimates at my side, with notes of the results of former experiments at hand, and assisted by the recollection of some hundreds of specimens.

Strychnine yields three kinds of sublimate: a sublimate consisting of a white spot or spots; a sublimate consisting of colourless drops, or a colourless waving pattern; and a sublimate consisting of the same drops, or waving lines, more or less discoloured by smoke. All the first sublimates of the series have the first form; the second variety shows itself when the alkaloid is nearly exhausted; the third when the alkaloid, being also nearly exhausted, is submitted to excess of heat. Of the watered and smoked varieties I will merely observe that, though not characteristic in themselves, they may behave quite characteristically with certain reagents, of which I shall speak presently, and that, therefore, they ought not to be rejected.

The sublimates which belong to the first class consist of a single white spot, often, though not always, circular, and often surrounded by an outer circle of mist; or of several circular spots, distinct or coalesced. Fig. 1 shows a spot of this compound form of natural size, as seen by a good transmitted light. These white spots or sublimates present, under the microscope, many forms. I will specify those with which I am most familiar.

Fig. 1.

1. Smooth uniform layer, bordered with a sort of fringe or lacework.

2. The same, but with the layer made up of minute disks.

3. The same, but sprinkled with a fine black dust.

4. The same, but with black feathers, fern-leaves, or furze-bushes, or with groups of feathers or leaves, projecting from the layer or crust.

5. Sublimate of varying thickness, white or opalescent, consisting of parallel waving or curved lines, conchoidal patterns, straight twigs radiating from a point, fine trellis or lattice-work, and various arborescent forms.

6. Confused mixture of square or oblong patches, finely

marked with radiating or concentric lines, discs, prisms, needles, and arborescent forms.

7. Detached crystals blended with any of the foregoing forms, and assuming the shapes of the crystals deposited from solutions in alcohol, ether, benzole, chloroform, or fusel oil; —prisms, rosettes, groups of needles, square and oblong plates, envelopes, and well-marked octohedra.

8. Surrounding any of the foregoing sublimates a thin mist, consisting of colourless globules, or a colourless waving network; or the same discoloured by yellow or yellowish-brown empyreumatic matter.

Of the dark-feathered crystals of No. 4, I may remark that they are such as gather on the lip of a short reduction-tube, when we adopt that mode of sublimation. Many of them, in shape and colour, resemble some of the finer crystals of the silver-tree, obtained by placing a fragment of zinc in a drop of a solution of nitrate of silver (one grain to eight fluid ounces) on a glass slide (fig. 2).

Fig. 2.

The description which I have just given is such as any person experienced in crystallization on the small scale, in whatever way the crystals may be obtained, would have expected. And I may state at once, as the result of large experience of the sublimates of strychnine, that it would be unsafe to infer their composition from their form. It can only be stated, in general terms, that the compound crystals of strychnine (the lattice-work especially) are generally built up of elements arranged at right angles. Curved forms are rare, and oblique arrangements also, except in the dark-feathered or fern-like crystals of No. 4.

But though we cannot infer the composition of the sublimate from its microscopic characters, we *can* draw certain safe inferences from the incidents of the sublimation itself. We have been dealing with a sparkling crystal, or particle of white powder; it has changed colour and yielded sublimates, melted and yielded others, dried into a black spot of carbon, and, in doing so, still yielded sublimates. I might add, that the darkened and melted alkaloid did not travel over the porcelain slab, but left its black spot where the substance was first placed. From these facts I infer that my crystal or speck of white powder must be either an alkaloid, glucoside, or analogous substance, or some substance of which we have at present no knowledge, that also darkens, melts, yields sublimates, and deposits carbon. And if, before I sublimed the substance, I

had been told that it was one of a poisonous character, and probably strychnine, the presumption in favour of that particular poison would have been greatly increased. Let me mention some of the poisons which the results of the process would have excluded.

Arsenious acid would have been shut out; for that poison is wholly sublimed, without change of colour or residue, the sublimate consisting of brilliant octohedral crystals; and *corrosive sublimate*, for it also is sublimed without change of colour and without residue, and yields a sublimate not to be confounded with any sublimate of the alkaloids. The active principle of the blistering fly, *cantharadine*, too, would have been excluded; for it sublimes without residue or previous change of colour. Then, among the alkaloids themselves, *solanine* would have been excluded by the form of its sublimate, which is very characteristic; and *veratrine*, of which the sublimate assumes the form of detached crystals. Then, the very peculiar development of the milk-white spots in the thin mist will probably be found to occur only in the case of strychnine, morphine, and of one or two other alkaloids at the outside.

But happily we are able to convert this likelihood into absolute certainty, by treating the sublimate with appropriate reagents. We owe this good fortune to a circumstance which was hardly to be expected, that, in spite of change of colour, melting, and deposit of carbon, the vapour given off by strychnine holds the alkaloid itself in suspension; as is proved by the occurrence in many sublimates of detached crystals, such as we meet with in deposits from solutions of strychnine, as well as by the close resemblance of the reactions of the sublimate to those of the commercial alkaloid and its solutions, and the solutions of its salts.

Among these reactions there is one of great delicacy and beauty, known as the *colour test*. When a drop of strong sulphuric acid is added to a particle of pure strychnine it dissolves it without change of colour; but if we bring this acid solution in contact with a minute particle of peroxide of manganese, peroxide of lead, bichromate of potash, ferridcyanide of potassium, or permanganate of potash, a rich blue, passing quickly into other colours, is produced, and stamps the substance as strychnine. Now, this reaction takes place with the sublimates of strychnine, and, as I have good reason to believe, more certainly than with the alkaloid in any other form. It succeeded, for instance, in two *sublimates* containing each the $\frac{1}{5000}$th of a grain, when it failed with two *deposits* from a solution in ether containing

the same quantity; and I may state, in illustration of the great delicacy of this reaction, that on dissolving one of the sublimates spoken of in this paper, which certainly did not contain more than the $\frac{1}{10000}$th of a grain, in the strong acid, and bringing a thin line of the acid solution in contact with a speck of each of the colour-developing substances in turn, the characteristic rich blue, followed by the equally characteristic changes of colour, took place in each instance, and with marked brilliancy and distinctness in the case of the permanganate of potash. Here the $\frac{1}{50000}$th of a grain gave a distinct reaction.

In applying this test, it is not necessary to resort to the aid of the microscope. But I am now to speak of two reactions in which the use of this instrument may be invoked with the greatest advantage and with equal confidence. The test solutions should be applied to the sublimates under the microscope, and the immediate effect, as well as the more remote effects, carefully observed. And here I would take occasion to insist on the special value of the instantaneous or speedy effects of our reagents, as observed under the microscope, in all cases in which they consist of saline solutions. For these solutions, I need scarcely observe, themselves leave crystalline deposits, especially at and near the outer margin of the drop; and it very rarely happens that the reagent is so nicely proportioned in strength and quantity as not to leave its own crystalline deposit blended with that due to the reaction itself. This is one of those fallacies of observation against which we cannot be too much on our guard; and the reality of the danger cannot be better proved than by the fact that Helwig himself, though well aware that such mixed results are of common occurrence, nevertheless, both in his descriptions and in more than one of his photo-micrographs, shows how easy it is to neglect this most obvious and familiar precaution. In order, then, to guard against this fallacy, and to be able to distinguish in the dry result of a reaction the appearances due to the reaction and reagent respectively, the first step to be taken is to procure, and figure for reference, the crystalline forms yielded by the reagent itself; and, as I am about to treat of two reactions with the sublimates of strychnine, to which I have been led to attach great importance, I will first present to you the appearances worn by the reagents in question when they are allowed to dry on a glass disk or slide.

The *first* of these reagents—a solution of bichromate of potash ($\frac{1}{100}$)—presents, with a solution of this strength, the form shown in Pl. I, fig. 10.

The *second*—a solution of carbazotic acid ($\frac{1}{250}$)—puts on, when dry, the appearances shown in fig. 11.

I take this opportunity of submitting photographs of one other test—the *nitro-prusside of sodium*, which not only yields a very beautiful arborescent crystal, but appears to be somewhat modified and improved by more than one of the alkaloids (see fig. 12).

The effect of the *bichromate of potash* is sometimes instantaneous, often speedy, occasionally slow. It varies, probably, with the thickness and character of the crust, and is influenced by other causes difficult to determine. When instantaneous, the crust is dissolved, and the whole field is sprinkled over with groups of fine prisms, radiating from a point and projecting into the field; when more slowly formed, the field is strewn with thin plates of various forms, among which the square plate is most common. When the process goes on still more slowly (and this seems to happen most frequently with the thicker crusts) groups of larger plates, square and oblong, triangular and irregular, spring up in blank spaces of the crust formed by its partial destruction. The colour of these crystals, in all their forms, is a lemon-yellow by transmitted, and a rich golden by reflected, light. The dry crust shows one or more of these forms blended with the arborescent crystals of the reagent. This reaction is, I believe, quite characteristic. (See Pl. II, fig. 16, from which all crystals of the reagent are omitted.)

The effect of the *carbazotic acid* is equally characteristic, and much more uniform in its occurrence, and constitutes a test for strychnine, upon which, I believe, that the utmost reliance may be placed. Helwig, who describes the reactions of this test with solutions of the salts of strychine, but not as a test for its sublimates (for he only describes the reactions with the sublimates of distilled water, liquor ammoniæ, dilute hydrochloric acid, and dilute chromic acid)—Helwig describes this acid as among the most delicate tests for strychnine, and says that a solution containing one part in 20,000 will develope sharply-defined crystals. Dr. Letheby also, in his papers published in the 'Lancet,' in the months of June and July, 1856, figures the crystals formed by carbazotic acid and the acetate of strychnine, as seen in the dry spot. Helwig, following the entire reaction as it takes place under the microscope, describes the formation of delicate, greenish-yellow "millfoil-leaves," and, at the close of the reaction (in the dry spot), large colourless plates, which are, doubtless, the crystals proper to the reagent. But he does not notice that which forms the leading feature of four

several reactions of a solution of the muriate of strychnine and carbazotic acid, confirmed by like reactions with the acetate, nitrate, sulphate, and phosphate of strychnine (three with each), namely, groups of curved crystals waving in the liquid like tufts of grass. Figure 3 shows these curved crystals as they appeared in the dried spot resulting from the reaction of carbazotic acid with a solution of the phosphate of strychnine. It is of these tufts of curved crystals and layers of "millfoil" that I am now to speak as developed, when a solution of carbazotic acid is dropped upon the sublimate of strychnine.

Fig. 3.

This reaction is not instantaneous, but very speedy. Sometimes, however, the transparent solution thickens as it touches the spot, just as, when added to a solution of a salt of strychnine, a dense precipitate is formed. But the reaction commonly shows itself, after the lapse of a minute or two, in the development of circular, greenish-yellow spots, in the centre of which a still darker spot appears. These spots grow in size, and soon display an arborescent form; and still growing, often coalesce with neighbouring spots to form a large continuous layer, or they remain distinct. In these spots themselves, and often as separate formations, that feature of the hook or claw to which I wish specially to invite attention develops itself, sometimes springing up into the liquid, sometimes lying flat upon the glass, and often forming a delicate and characteristic fringe to the yellow carpet into which the coalesced spots have formed themselves. In the dry spot, the coarse prisms, groups of needles, and long colourless plates, or plates with markings like those of the common razor-shell of the seashore, all belonging to the reagent, intrude themselves, and tend to confuse the bright yellow patterns, like delicate sea-weeds, and the bundles of hooks which result from the union of the carbazotic acid with strychnine. Some of these curved forms, in the case of the sublimate, and several in the case of the solutions of the salts of strychnine, are delicately feathered. Sometimes, though rarely, and then in the case of the coarser sublimates, these peculiar hooks or claws are absent; but the distinct arborescent forms, forming and growing under the eye, are always present, and, as I have reason to believe, are also characteristic. Sometimes, again, when the sublimate of strychnine consists of well-marked crystalline forms,

the lines forming the crystals remain distinct, and the curved lines form a border to them.

No such reactions as these occur either with morphine or brucine, or with any other alkaloid with which I am acquainted; and as to this reaction with strychnine, I believe that I am justified, by certainly upwards of a hundred experiments at the least, in speaking of it as equally uniform in occurrence, delicate in succeeding with the smallest sublimates, and characteristic in the appearances which it puts on (fig. 17).

I begin what I have to say of the alkaloid *morphine* by comparing its reaction with carbazotic acid with that just described. Its characteristic feature appears to be the formation, at or near the very margin of the spot, of coarse yellow masses, approaching the circular form, single, double, like a dumb-bell, or triple, like a *fleur-de-lis*. The reagent seems to contribute largely to these spots, for its own crystalline forms are rarely to be seen in the dry spot (fig. 18). With the sublimate of *brucine* the carbazotic acid produces a brown, mottled pattern, with, in some parts of the field, a curious growth of twisted and gnarled roots (fig. 19).

My remaining observations on the sublimates of this alkaloid must be condensed into as few words as possible. Morphine, like strychnine, yields its crystalline, its watered, and its smoked sublimates; and, like strychnine, the milk-white circular patch may be seen forming on the disk of glass. But the alkaloid generally melts before the sublimates begin to form, and yields fewer sublimates before it is exhausted and reduced to a spot of charcoal. It is probable that the minimum quantity which will yield a sublimate is more than the $\frac{1}{10000}$th of a grain, which suffices in the case of strychnine. I think that it may be stated at some such quantity as the $\frac{1}{2500}$th of a grain. The thicker sublimates very generally present a distinct crystalline arrangement, and the prevailing element in their structure is the sweeping curved line so rarely seen in the sublimates of strychnine. The body of the sublimate accordingly is made up of very graceful figures, and the fringed border resembles more some delicate twisting weed than the mossy border of the strychnine crust. The dark penniform and fern-like crystals which I mentioned when speaking of strychnine are also common in the sublimates of morphine (fig. 20).

The reactions of morphine contrast strongly with those of strychnine. The sublimate is very soluble in water, caustic ammonia, dilute hydrochloric acid, and solution of bichromate of potash; and the crystals are remarkable for their size, brilliancy,

and beauty of form, no less than for the magical quickness with which they spring up and spread. Their colour, again, is peculiar, and may be fitly compared to that of smoked quartz; and they often rest upon a uniform brown layer, which cracks as it dries, and throws off the crystals, which adhere lightly to its surface. The finest crystals are often yielded by the smoked variety of sublimate. They are sometimes detached masses tilted upwards, nearly circular, like grindstones; but they often assume the form of such insects as the dragon-fly, the wings being beautifully marked with radiating lines. In the dry spot they become, as it were, entangled in the brown cracked layer of which I have just spoken (fig. 25). The reactions with ammonia (fig. 24) and spirits of wine (fig. 23) show some curious crystalline forms; and the large drops of the smoked sublimate are sometimes filled with dark tracings. These drops, too, show these dark tracings instantaneously, on the addition of carbazotic acid (fig. 21).

Of morphine sublimates it may be stated, that they contrast with those of strychnine by their greater solubility no less than by the size, brilliancy, and strange forms of the crystals which result from their reactions.

Of the other alkaloids I have little to say at present. I content myself with showing photographs of two of their number—*meconine,* with its tufts; and the new alkaloid, *cryptopia,* with its beautiful stellate patterns (figs. 7 and 8). I also show one photograph of the sublimate of an animal product—*hippuric acid* (fig. 9).

I now bring this paper to a close, and trust that the Society will accept it as a brief, though not a careless or superficial introduction to a large and very important subject, in the treatment of which I may claim to have had very considerable experience of the peculiar method of sublimation which it has been my desire to explain and recommend.

*** It may be well to explain that the paper, when read to the Society, was illustrated by a series of admirable microphotographs by my friends, Dr. Julius Pollock and Dr. Maddox, from which photographs, aided by the objects themselves, the drawings of Mr. Tuffen West were made. These illustrations, equally faithful and artistic, may be found in one or two instances not to correspond precisely to my verbal description in the text. Where this is the case, the verbal description must be preferred, as it is based on the examination of many specimens, and fairly portrays their general features. For the specimens of the alkaloids which have yielded the sublimates, I am indebted to the Messrs. Morson, with the exception of the new alkaloid, Cryptopia, kindly given to me by my friend Dr. Cooke, of King's College.

On a Peculiar Distribution *of* Vein *in* Leaves *of the Natural Order* Umbelliferæ. By John Gorham, M.R.C.S., &c.

(Communicated by Jabez Hogg, Esq., F.L.S., Hon. Sec. Roy. Mic. Soc.)
(Read Nov. 13th, 1867.)

Some short time since I was induced to examine the mode of distribution of the veins in the leaves of that extensive and difficult family belonging to the natural order Umbelliferæ. Difficult and distasteful as this order had always heretofore appeared to me, notwithstanding the charm with which its classification had been invested by the beauty and symmetry of the sections of its points (pericarps), it was not long before I was induced to alter my opinion, for, as leaf after leaf came under review, a freshness, a character, an individuality, seemed to spring up and portray itself in each; and after some twenty or thirty specimens had been examined I was almost constrained to admit, not only that my prejudices were unfounded, and that the plants themselves were really very beautiful, but, further, that it was sufficient merely to investigate this particular portion (venation) of the plant in order to determine its species—a conclusion which, so far as my present experience will permit me to decide, I do not feel disposed to modify, and less to forego.

Before proceeding to the immediate subject of this paper I would beg to make a few remarks, at the risk of appearing somewhat egotistical, as to my investigation of leaves in general, with a view to their venation, and I do so for the purpose of clearing the way, of showing, in other words, the grounds of any claims I may have on the attention of the Fellows of the Royal Microscopical Society of London, but especially in answer to a very pertinent question which has been put to me by the Honorary Secretary of the Society, as to "Whether I have examined other classes, and feel sure that the mode of venation I have presently to describe is not pretty general, rather than confined to the Umbelliferæ?" Now, in answer to this question, it is necessary that I should state that so long since as 1845 I made a collection of many thousands of leaves, taking their impressions, and classifying them, in order to illustrate every mode of venation that was described by Dr. Lindley. Many of the impressions of leaves forwarded by myself to this celebrated botanist were submitted to him for the purpose of showing that a place could not be found for them in any single class, owing to the twofold character of their venation—one part of the leaf

presenting one kind of venation, another part of the same leaf another kind of venation. Take, for example, the common sow-thistle (*Sonchus oleraceus*); the lower portions of this leaf are true *feather veinal*, while the upper portion, on the other hand, is as *truly notted*. This leaf, therefore, furnishes us with an example of the transition or connecting link between these two kinds of veining, and its position when classified is intermediate.

Many examples of this and analogous transitions were furnished to the late Dr. Lindley, who expressed his obligations to me in the course of a correspondence.

There is, be it observed, no paucity of leaves in the county of Kent. I had abundant means, therefore, at my command for specimens. Neither were any pains spared to make a thorough investigation of them, so that, after collecting and classifying a goodly number in strict accordance with the received nomenclature, my labours for the time seemed to have come to an end, and I rested satisfied that, so far as the venation of leaves was concerned, I at least knew nearly all about it.

But when recently, and after a lapse of some twenty-two years, I began for a special purpose to re-examine the distribution of the veins in leaves, and when I found a peculiar vein occupying a perfectly different position in the leaf to that of any heretofore seen by myself or, so far as I could find, described by others, it seemed to me that the position and course of such a vein were worthy of notice and description. Hence this present communication.

It may be as well here to premise a few remarks as to the simple experiments by which the result of my inquiries were arrived at. In the first place, the leaves themselves were pressed, well dried, and then mounted between two slips of glass. No one should ever grudge the time spent in carefully putting up an object for the microscope, for a well-mounted object affords such facilities for its examination that the specimen itself becomes doubly valuable. The glasses are three inches square, this size being found sufficiently large to hold a leaflet which is placed between them, and the edges are then secured with gummed paper. Leaves thus treated will keep for years, retaining their integrity, while the veins become bold and sharp, and stand out in stronger relief as they become drier by age.

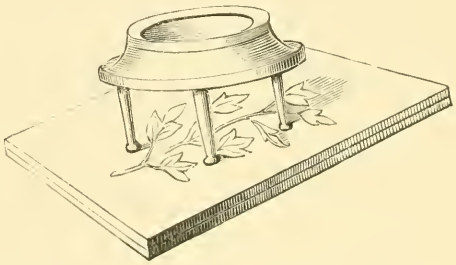
With regard to the lenses used for examining the veins in leaves, I have found a magnifying power of about twelve diameters amply sufficient to show every vein from the mid-rib in the centre to the finest reticulations in the margin. A

far better idea is gained, indeed, of the structure and real appearances of any object by using the weakest power compatible with correct definition, than by a display with a regular microscope, which shows only small detached parts prodigiously amplified. As microscopists, it is possible we have paid too little attention to a large class of objects requiring powers intermediate between those of the naked eye and those of the highest magnifiers to make them visible.

Instruments of low powers, though by far the most amusing, and in many cases the most useful instruments also, seem to have been quite neglected, while the higher powers have been brought to the greatest perfection of which, perhaps, they are capable.

It must be recollected, however, that the more we magnify any object, the less we must be content to see of it, according to the law of optics.

A lower power, then, with a wide field, becomes a most useful optical instrument for examining the structure of leaves; and if it be placed on a tripod, the proper focus may be obtained once for all, and thus a large number of leaves may be examined easily and expeditiously.



It may be necessary to view the specimens either by transmitted or by reflected light. If the greater spaces are to be investigated, the glass should be held up before the window, when the reticulations will be seen presenting a firm, transparent, and often coloured network, the colours differing from that of the leaf itself, and often conferring great beauty and brilliancy upon it. If, on the other hand, it is desirable to notice the veins at the margin of the leaf, they will be seen to the greatest advantage by holding the glass horizontally in front of the window and placing a piece of white paper underneath, so as so view them on a white ground.

The anomaly of a marginal venation in a leaf to which I am about to direct attention will be better understood, and more properly appreciated, I presume, if the ordinary modes

of distribution of the fibro-vascular tissue in leaves generally are first considered.

To prosecute the study of the venation in leaves with advantage, it is necessary to have appropriate names for all the varieties of veins that may possibly present themselves in a perfectly formed leaf (netted), and then rigidly to classify them, so that every leaf that may be presented for our inspection may have its proper place assigned to it as regards its mode of venation.

A perfectly formed netted leaf, such as we find in the lilac, the rose, burdock, the peach, the nectarine, and in dicotyledonous plants generally, was chosen by Dr. Lindley for this purpose; and a reference to the mode in which any given vein named in this leaf distributes itself in other leaves furnishes at once a clue to their classification.

The midrib (1, 1, Fig. I) in a perfectly formed netted leaf, sends forth alternately, right and left, along its whole length, ramifications. These are called primary veins (2, 2, 2, 2). They diverge from the midrib at various angles, and pass towards the margin of the leaf, curving in their course, and finally forming a junction or anastomosis with the back of the vein which lies next them. That part of the primary vein which lies between the junction thus described, having a curved direction, may be called the *curved vein* (3, 3, 3). Between this latter and the margin, other veins, proceeding from the curved veins, occasionally intervene. They may be distinguished by the name of *external veins* (4, 4, 4). The margin itself and these last are connected by a fine network of veins, *marginal veinlets* (5, 5, 5).) Lastly, from the midrib are generally produced, at right angles with it, and alternate with the primary veins, smaller veins, which may be called *costal veins* (6, 6, 6). The primary veins are themselves connected by fine veins,

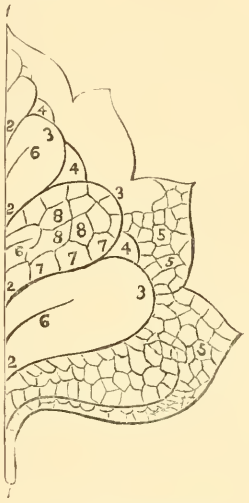


Fig. I.—*Netted leaf.*

1, 1. Midrib.
2, 2. Primary veins.
3, 3. Curved veins.
4, 4. External veins.
5, 5. Marginal veinlets.
6, 6. Costal veins.
7, 7. Proper veinlets.
8, 8. Common veinlets.

which anastomose in the area between them. These veins, when they immediately leave the primary veins, may be called *proper veinlets* (7, 7, 7); and when they anastomose, *common veinlets* (8, 8, 8).

In the *feather-veined* leaf (see Pl. III, fig. 6), the primary veins diverge from the midrib in right lines, and lose themselves in the margin; while, if the same veins are *curved* instead of straight, the leaf is called *curve-veined* (Fig. 5).

But the different modes of venation are clearly shown in the analysis at the commencement of this paper, and which I have tabulated for the purpose, so that they will not require to be repeated in this place.

In the foregoing remarks, and in the table of venation, I have adhered rigidly to the distinctions given by Lindley, distinctions which, as the doctor observes, may to some appear over-refined; while at the same time he states his convictions that no one can accurately describe a leaf without the use of them, or of equivalent terms yet to be invented.

A cursory examination will suffice to show that many kinds of venation, defined in the foregoing table, are to be found amongst the leaves of the Umbelliferæ. The *netted* leaf is seen in *Sium latifolium;** the *feather veined* in *Heracleum Sphondylium*, and *Angelica sylvestris;* the *falsely-ribbed* in *Pimpinella Saxifraga*, *Sanicula Europæa*, and *Bupleurum fruticosum.** This last is an exotic; and when examined by the naked eye only, is sufficiently peculiar to excite admiration; but under the lens, and by transmitted light, its reticulations are surpassingly beautiful. A *ribbed* leaflet is seen in *Peucedanum officinale.* Examples of the *radiating* leaf are found in the *Eryngium maritimum*,* and in *Sanicula Europæa.*

It is not my intention, however, to notice the venation in every individual species of this interesting group of plants, but rather to point out a peculiar distribution of vein which I have found to occur in several of them, and of which, so far as I can ascertain, no mention has been made either in our systematic works, when treating of the organography of flowering plants, or in our manuals of descriptive botany.

As this deviation from the ordinary course of a vein is, so far as I have noticed, constant for the same species, and as invariable in its direction as that of other veins in other classes, it would seem to merit a particular description.

It was while examining a fresh specimen of *Æthusa Cynapium* (fools' parsley)* that my attention was aroused by the

* See mounted specimens.

curious anomaly, as I supposed, of a vein which seemed to be situate at the very margin of the leaf, but which was especially visible at the edges of its lobes. The question naturally arose whether the supposed vein was a vein at all, or whether the appearance was due to a thickened state of the margin of the leaf.

FIG. III.—*Leaflet of Æthusa Cynapium.*

Showing the primary veins (p, p), the proper veinlets (v, v, v) proceeding from the primary veins, bifurcating at the sinus or angle of the lobes (s, s, s), and becoming confluent with a vein which entirely surrounds the leaf at its very edge or margin, forming the *marginal-veined leaf.*

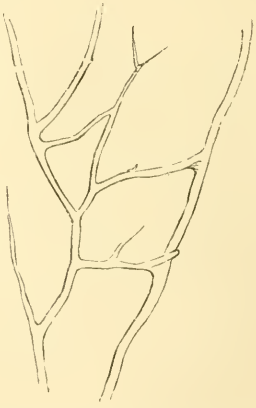
Happening to have by me a dried specimen of a leaf from the same species, which had been left accidentally in a manual of botany many years since, I submitted this leaf to examination, when I discovered that the supposed veins could be seen distinctly, and could be traced without trouble to the sinus of two adjacent lobes, where they met with a single vein proceeding from the interior of the leaf, and which bifurcated and became confluent with them.* The next leaf which came under notice was that of the *Œnanthe crocata* (water dropwort). (Pl. III.) In this leaf the actual existence of the vein was even still more evident, and a smaller veinwas seen clearly to proceed to the angle of the lobes, there to divide into two portions, which emerged and traversed the

* See mounted specimens.

very margin of the lobes. In order to assure myself that these appearances represented realities, and that the supposed veins were real ones, I enclosed the two specimens, the dried one of *Æthusa Cynapium* and the fresh leaf of *Œnanthe crocata*, to Mr. Jabez Hogg, who submitted them to careful examination under a power of 50 diameters, and kindly enclosed to me a very succinct account of their microscopic appearances, accompanied by a couple of diagrams. The insertion of this memorandum, together with a sketch of the diagrams, will, I am sure, not be offensive to Mr. Hogg. He says, "My rough sketch will show you that I entirely concur in the view you have taken. I submitted the leaf to a power of 50 diameters, which is the best to determine one in the opinion that the venation (fibro-vascular tissue), as it proceeds from the stem, is distributed to the outer portion of the leaf, and runs on to the summit of the apex, where it unites and comes to a point with its fellow of the other side. At the angles of the leaf the vein bifurcates, and gives off a portion of itself to each side of the leaf, forming a marginal portion of each.

"In *Œnanthe crocata* it appears to differ slightly, inasmuch as the leaf is thicker, the layer of parenchyma is greater, and the veins appear to enclose a thin layer of the

Magnified portion of leaf of *Æthusa Cynapium*, showing *venation*.



Outer layer of fibro-vascular tissue. *Veins.*

colouring matter of the leaf, so that one can see the chlorophylle between two dark veins; but here, as in the former case, the veins form a marginal frame, as it were, to the parenchyma.

"Viewed with the binocular, you see that the veins are not *imbedded* in the parenchyma, but partially raised above it, giving strength and support to the whole."

In a correspondence with Dr. Maxwell Masters on this subject, this gentleman tells me that he has found the vein at the margin more or less distinct in the Umbellifers—Nos. 1, 2, 6, 8, 9, 10, 16, 17, 18, 19, 20, 24, 25, 26, 27, 32, 33, of the following list. I have noticed the vein myself in the rest, and in fourteen of those mentioned by Dr. Masters.

1. *Apium graveolens.* Celery.
2. *Æthusa Cynapium.* Fools' parsley.
3. *Bupleurum tenuissimum.* Slender hare's ear.
4. *Carum Carui.* Caraway.
5. *Caucalis daucoides.* Small-bur parsley.
6. *Chærophyllum sylvestre.* Wild chervil.
7. ,, *temulum.* Rough chervil.
8. *Cicuta virosa.* Water hemlock.
9. *Conium maculatum.* Common hemlock.
10. *Daucus Carota.* Common carrot.
11. *Eryngium maritimum.* Sea holly.
12. ,, *campestre.* Field eryngo.
13. *Helosciadium nodiflorum.* Procumbent marshwort.
14. ,, *repens.* Creeping marshwort.
15. ,, *inundatum.* Lesser marshwort.
16. *Libanotis vulgaris.* Mountain meadow saxifrage.
17. *Myrrhis odorata.* Sweet Cicely.
18. *Œgopodium podagraria.* Gout weed; herb Gerarde.
19. *Œnanthe crocata.* Hemlock waterdrop.
20. ,, *pimpinelloides.* Parsley waterdrop.
21. ,, *fistulosa.* Common water dropwort.
22. ,, *Phellandrium.* Fine-leaved water dropwort.
23. *Pastinaca sativa.* Parsnip.
24. *Petroselinum sativum.* Parsley.
25. ,, *segetum.* Corn parsley.
26. *Pimpinella Saxifraga* (?). Common Burnet saxifrage.
27. ,, *magna.* Greater Burnet saxifrage.
28. *Peucedanum officinale.* Sulphur weed.
29. ,, *sylvestris.* Milk parsley.
30. *Scandix Pecten-veneris.* Venus's comb.
31. *Silaus pratensis.* Meadow pepper saxifrage.
32. *Sison Amomum.* Stone parsley.
33. *Smyrnium olusatrum.* Alexander.
34. *Torilis Anthriscus.* Upright hedge parsley
35. *Trinia glaberrina.* Glabrous stonewort.

So that about one half of the plants belonging to the

natural order Umbelliferæ, and doubtless several more not yet examined, have their leaves bordered or fringed with a thickish vein.

But of all the varieties in venation those which are seen in the two Eryngia (*Eryngium maritimum*, sea holly, and *E. campestre*, field eryngo) are perhaps the most singular and illustrative of the vein in question.

In *Eryngium maritimum* the leaf, says Sir Wm. Hooker, is "beautifully veiny." This is true; but the same remark will apply to more than half the leaves of this order, if the eye is assisted by the use of a lens of moderate power in their examination. Nevertheless, there are peculiarities in the veining of this leaf which are not to be found in any other plant, excepting *Eryngium campestre*, amongst all the Umbelliferæ. Its veins are prodigiously large, and, when the leaf is well dried, look more like massive skeletons of ivory or carved woodwork than delicate veins of leaves. Almost all the veins, too, are visible to the naked eye, especially those at the margin, which are exceedingly thick, well defined, and are essentially typical of what I have ventured to call a marginal venation. Besides which, every vein is seen to be much bigger at its termination than at its origin, and every primary vein enlarges as it proceeds towards the circumference, until it terminates in a bulge, which finally tapers off abruptly into a spine. In fact, the leaf presents us with the curious anomaly of having almost every *costa, vein,* and *veinlet,* larger at its termination than at its commencement. Hence the central costa is actually narrower than the vein by which the circumference of the leaf is bounded.

From the whiteness of the veins the leaf is seen to best advantage on a black ground—a piece of black paper, for instance, held under the glasses in which the leaf is mounted; and as the magnitude of the vein at the margin, conjoined with the fact of its anastomosis with so many other veins, precludes the possibility of its being mistaken for a mere thickened margin, and as the costæ themselves, as they ramify within the leaf, are radiating, I propose to class such a distribution by itself, under the name of *Radio-marginatum.*

The *Eryngium campestre* (field eryngo), which is becoming extinct, is similar to the sea holly in the magnitude and whiteness of its veins, but dissimilar in their distribution. The field eryngo is feather-veined (pennivenium). I would, therefore, classify it under the name of *Marginato-pennivenium.*

Again, the leaf of *Bupleurum rotundifolium* (common

hare's-ear or thorow-wax) has no proper place assigned to it in our present classification.

This leaf is disposed of by Sir William Hooker, of course without any allusion to its venation, as "perfoliate roundish oval." Its veins are, nevertheless, distributed in a manner so remarkable, as to characterise this leaf from all the other Umbelliferæ. A cursory examination only would leave the impression that it was a *ribbed* leaf; but, on closer inspection, it will be seen that, although the costæ have one common origin, and proceed in curves *towards* the apex, yet that they never reach it, but join back to back, forming curves like the venæ arcuatæ in a netted leaf, and these, again, are joined by a few straggling veins which pass to the margin.

This leaf, therefore, is not a *ribbed* leaf, because none of its costæ pass to the apex. It is not a netted leaf, because it has no primary veins; but it partakes partially of the twofold character of both. Hence I would suggest that its proper position should be called *Costato-reticulatum.*

It may be presumed that the addition of a marginal vein in the leaves of the Umbelliferous class is for the purpose of giving solidity and strength to the leaf. I have seen the integrity of leaves destroyed by caterpillars, parasites animal and vegetable, and burns from the concentration of the sun's rays by drops of rain, but I have never yet seen a leaf *torn* by the wind. This power of resistance is to be attributed partly to the flexibility and elasticity of the boughs and branches, but also to that due adjustment of the fibro-vascular tissue to the parenchyma, the skeleton to the green part of the leaf, whereby this latter becomes expanded in space and supported. Now, the leaves of this order are, many of them, exceedingly thin. Every one at all conversant with the subject will know that if such leaves are not submitted to pressure almost as soon as gathered, they curl up and are troublesome to be laid out on paper. Take, for example, the leaves of Conium, *Æthusa cynapium, Sison amomum,* and a host of others, when, on the contrary, the parenchyma is thicker and stronger, the necessity for the vein no longer exists, as in Heracleum, Angelica, and others, while the leaf of *Apium graveolens* (celery) is so thin that a small type may be read through it when held up to the light.

The number and course of the veins is, no doubt, very nicely adjusted to the requirements of the leaf, amongst which a state of extreme tenuity would appear to demand a peculiar provision. The netted cordage which envelopes a balloon contributes, doubtless, in no small degree, to its safe ascent, and its return to the earth without bursting; while

the absence of this in a boy's kite, which has, so to speak, only a marginal vein outside, and a midrib in the centre, is the reason why it is so often torn into tatters.

In the foregoing brief and very partial survey of the veins in the Umbellifers, sufficient has been said, I trust, to make that portion to which I was anxious to direct attention clear and intelligible; while it may serve to show, also, that the distribution of the veins in leaves, in this as well as in many other natural orders of plants, will bear revision, which, when accomplished, will render the description more complete, and so facilitate classification. It is clear that the examination of the leaf in the way described in this paper is both interesting and instructive.

The truth is, that the different parts of a flowering plant often require lenses of different powers to define them clearly. It is then only that they become intelligible; for, as might naturally be expected, the more minute the object to be examined, the higher the power necessary to present it to the eye. This is well exemplified in a fern leaf during its fructification, although any other plant, having several organs, all differing in size, would do as well. In the fern the thin layer of cellular tissue (*indusium*) which envelopes the fruit is visible to the naked eye, but is seen to the best advantage by using a low power of from ten to twelve diameters.

Next in order come the *capsules* or *sporangia* (cases in which the seeds are contained). These demand a power of about from 80 to 100 diameters. Next the *spores* (seeds) themselves, which cannot be well defined under a power of less than 200 or 300 diameters. Besides these fructifying organs there are the veins in the leaves, which can generally be seen under about 12 diameters. In this way, and this only, by careful adjustment of the power to the size of the object, can the parts of a plant be presented to the eye intelligibly. For suppose the order of arrangement to be reversed—a strong power for an object of larger size, and a weak power for one of smaller dimensions—all would be confused and indefinite. The *spores* themselves would be seen only as amorphous specks of matter under a weak lens; and the *indusia*, under a strong lens, too little of their area being thus exposed to render their shape visible, would be reduced to a mere aggregation of dots of cellular membrane. The bursting of the sporangia, too, with the scattering of its spores, is a sight worth seeing under a weak power, the spores shooting in all directions across the field of view. This is well shown in a recently gathered frond of Scolopendrium, the transit of the spores reminding one of the saltatory movements observable

in certain of the insect tribe, which are prone to disturb our peace, and especially to induce a strong presentiment of a nocturnal vigil.

By way of conclusion I would offer the following brief recapitulation:

1. That the distribution of the veins in Umbelliferæ is very variable in different species, but constant and highly characteristic in each species.

2. That many of the leaves of this order have a venation like that in other leaves, and may be classified with them; but that a considerable number of them, on the other hand, have a kind of venation peculiar to themselves, which does not find a place under any of the divisions that have heretofore existed.

3. That this peculiarity consists in the existence of a vein at the very edge of the leaf itself, and which, more or less, entirely fringes its whole margin.

4. That this marginal vein is to be found certainly in one half, if not more, of the species belonging to the Umbelliferæ, and hence that it may be said to constitute a form of venation peculiar to this order, and to give a character to it which does not belong to other orders of plants.

5. That when a leaflet is placed between two pieces of glass, and examined with a low power of 12 diameters, the vein becomes distinctly visible.

6. But that it is also visible, even to the naked eye, in certain of the species—*Eryngium maritimum, E. campestre, Silaus pratensis,* &c.

7. And, finally, that it is possible that a more attentive study of the venation of leaves in the manner recommended in this paper might prove of considerable assistance in the classification of plants.

For a full description of the veins in ferns I would beg to refer to the elegant volume, 'Ferns, British and Foreign,' by Mr. John Smith; but I am not aware that an analogous description of the venation in any one single order of flowering plants has ever been attempted.

I now beg to offer my thanks, first to the worthy Honorary Secretary of the Royal Microscopical Society, for the kind and flattering manner in which he has received and disposed of my paper; and, secondly, to the President and Fellows themselves, for the honour they have conferred upon me in allowing me to read and discuss its merits before them on the present occasion.

On the Anatomical Differences *observed in some* Species *of the* Helices *and* Limaces. By Edwin T. Newton, Geological Survey.

(Read December 11th, 1867.)

Although in all the pulmonated Gasteropoda the general type of structure remains the same, yet in the different species there are some important modifications of the various organs. Mr. Binney, in his work on the 'Land Shells and Mollusca of the United States,' has considered very fully the anatomy of many of the Pulmonata, and has given several plates of dissections. He, however, includes only a few of the species found in this country. A paper by Mr. Nunnely, in the first volume of the 'Leeds Society's Transactions,' treats of the comparative anatomy of the Limaces of that district, and some of the facts mentioned by him will be referred to in this paper.

The differences which we shall have to notice are—in the reproductive organs, where some of the parts become modified or suppressed; in certain additions to the alimentary canal; and in the variations which the muscles undergo.

The ovotestis in the Helices occupies the apex of the shell conjointly with the liver, with which, indeed, it is closely connected. In the Limaces it is perfectly distinct from the liver, and varies in different species as to its position with regard to other organs in the visceral cavity. In *L. maximus* it occupies the posterior extremity of the internal cavity; in *L. flavus* it is in front of the first flexure of the intestine; in *L. agrestis* it occupies a position beside the intestinal flexure; and in *Arion ater* it is situated midway between the posterior extremity of the visceral cavity and the flexure of the intestine.

Some of the accessory parts of the reproductive organs found in the Helices are absent from the Limaces. *L. maximus* and *L. flavus* do not possess either the dart, the flagellum, or the multifid vesicles; and all the Limaces have a short spermathecal duct. *L. agrestis* has at the internal extremity of the penis three short cæcal tubes, which occupy the position of the flagellum in the Helices (Pl. IV, fig. 4 *fl*). These appendages of *L. agrestis* are alluded to both by Mr. Binney and Mr. Nunnely. *L. Sowerbii* possesses the multifid vesicles, and in this species they consist of several ovoid masses, connected by very minute threads, or ducts, with the vagina, near its junction with the duct of the spermatheca (fig. 2 *g*). The spermatheca is proportionately large in *L. Sowerbii*, and

tapers at both extremities (fig. 2 *st*). Professor Allman ('Rep. Brit. Assoc.,' 1846, p. 82) notices that the multifid vesicles, and a peculiar dart, exist in this species, both of these organs relating it to the Helix. In *Arion ater* the cloaca forms a very definite chamber (fig. 3 *c*); within it is a fleshy body, which partly surrounds the entrance of the oviduct, and is of a subtriangular form, grooved, and crenulated at its margins (fig. 3 *x*). It will be noticed that this body, being placed just within the cloacal chamber, occupies very nearly the position of the multifid vesicles, which are generally situated immediately without it.

Professor Owen tells us in his "Lectures on the Invertebrata" that "a short cæcal tube is developed from the duct of the spermatheca of *H. pomatia*, and a very long one from that of *H. arbustorum*." *H. aspersa*, *H. nemoralis*, and *H. hortensis* have also this addition to the spermathecal duct. In the two latter it is, as in *H. pomatia*, only a short tube (fig. 8 *adst*); but in the former (fig. 7 *adst*) it resembles that of *H. arbustorum*, being considerably longer than the spermathecal duct itself. This additional tube enclosed a viscid white substance, which, upon examination with the microscope, was seen to contain spermatozoa. The presence of the spermatozoa here would lead to the inference that this tube is only an additional spermatheca. Swammerdamm thought it to be a duct of communication between the spermatheca and the oviduct, thus lessening in some measure the distance which the spermatozoa would have to traverse in passing from the former to the latter; but as it is not found in *H. cantiana*, *H. rufescens*, nor *H. virgata*, nor in any of the Limaces referred to in this paper, this idea is very improbable. It may be mentioned that the spermatheca of *H. cantiana* (fig. 10 *st*) is proportionately very large, and of a subtriangular form, though its duct is not so long as in most of the other Helices.

In *H. rufescens* there are immediately below the junction of the oviduct with the spermathecal duct four pyriform bodies, two upon each side (fig. 9 *d*); these are in the position usually occupied by the dart-sac, and there appear, therefore, in this instance, to be four of these organs, but darts were only to be found in the two lower bodies. As it often happens, in other species, that the dart is absent from its sac, it might be thought that it was the case here; but in all the individuals of this species which were examined darts were never seen in the two upper bodies, while they were invariably present in both the lower ones.

The dart-sac of *H. cantiana*, or, more correctly, that

which corresponds in position to this organ in other species, is a tapering tube (fig. 10 *d*), which by transmitted light presents the appearance of alternate lighter and darker rings. No dart was to be found in this tube in any of the specimens examined. Schmidt ('Zeitsch. f. Malakozoologie,' 1850, p. 1, and 1852, p. 1) considers the dart to be very important as a means of determining the relations of the species of Helix; and gives tables of those which possess two darts, of those with one dart only, and of those which are devoid of any dart. The only anatomical difference between *H. nemoralis* and *H. hortensis* appears to be in the form of the dart.

The flagellum, which in *H. aspersa* and *H. pomatia* is very long (Pl. V, fig. 7 *fl*), gradually shortens in *H. nemoralis* and *H. hortensis* (fig. 8 *fl*), *H. rufescens* (fig. 9 *fl*), *H. cantiana* (fig. 10 *fl*), and *H. virgata* (fig. 11 *fl*) and, as has been mentioned, is altogether absent from the Limaces.; *L. agrestis*, however, having the trifurcate gland in its place (fig. 4 *fl*).

The multifid vesicles present some variations in the different genera and species; *H. pomatia* and *H. aspersa* have them large and foliated (fig. 7 *g*), communicating by two ducts with the vagina; in *H. nemoralis* and *H. hortensis* (fig. 8 *g*) there are only two or three long cæcal tubes upon each side, which terminate, as before, by two ducts; these tubes vary in length in different individuals. In *H. rufescens* there are eight tubes, which open into the vagina by four ducts (fig. 9 *g*). In *H. virgata* they are irregular in form, and not laterally symmetrical (fig. 11 *g*).

Limax differs from Helix in the arrangement and number of its muscles. There are in the Helices two muscles, which have their origin, together with the retractors of the foot, buccal body, and tentacles, upon the columella of the shell, and are inserted into the parietes of the head immediately within the inferior tentacles. This pair of muscles was not found in the Limaces. The series of muscles which retract the foot in Helix are not present in Limax. The retractor muscle of the penis (when present) is attached in Helix to the floor of the pulmonary chamber, and midway between the extremities of the penis (figs. 7, 8, 9, and 11 *rp*), whilst in *L. maximus* and *L. flavus* it is attached to the extremity of the penis (fig. 1 *rp*), and behind the pulmonary chamber, somewhat towards the left side. In the *L. Sowerbii* and *L. agrestis* its attachment to the penis is the same as in the Helix (fig. 2 *rp* and fig. 4 *rp*). *H. cantiana* and *Arion ater* do not appear to possess this retractor of the penis. *L. Sowerbii* has an additional annular band of muscular fibres (fig. 2 *rp'*), which is attached to the penis at some little dis-

tance from its base, and to the parietes of the body around its base.

In consequence of the position of the great retractor muscles in the Limaces, the intestine curls round them shortly before entering the pulmonary chamber. In *L. maximus*, after making this curl round the muscles, the intestine passes along the dorsal surface of the visceral cavity nearly to the tail; it then bends sharply back and returns upon itself, terminating in the usual manner; there is a constriction at the last bend (fig. 5 *y*). *L. flavus* has, in place of this backward turn of the intestine, a large cæcum, which occupies a similar position (fig. 6 *a'*). Mr. Binney notices a small cæcum upon the rectum of *L. agrestis*.

It appears to be a general arrangement in both the Helices and Limaces that the retractor muscle of the right superior tentacle should pass between the male and the female reproductive organs. The position of the generative orifice being further back in Arion would lead us to expect a change in this arrangement, and we accordingly find in *A. ater* (and it may be the same in other species of this genus) that it passes altogether below these organs. *L. Sowerbii* is another exception to this general arrangement, although the opening of the reproductive organs occupies the normal position.

Having, by the great kindness of Professor Busk, had access to notes made by him some years back upon this subject, and which chiefly relate to the microscopic contents and structure of the various portions of the reproductive system, I am enabled to append the general results of his observations.

The ovotestis, like most of the other organs, was found to vary much, as regards its contents, in different individuals. Sometimes it contained abundance of spermatozoa, both coiled and uncoiled (fig. A), with granular cells (fig. B) and active molecules, the molecules being occasionally contained in cells, in which case they were most active. At other times there were but few spermatozoa, with nucleated cells, some being in groups (fig. C), and active molecules. Again, in other cases there were found transparent cells with granular nuclei, which burst readily in water; small granular cells, with highly refracting nuclei; and small transparent cells, apparently having no nucleus. In the ovotestis of a *H. aspersa*, taken whilst laying its eggs, there were transparent globules of various sizes (fig. D), which were rendered opaque by acetic acid, and with these a few nucleated cells.

The epididymis, in almost every case, contained sperma-

tozoa, both coiled and uncoiled, and in some instances forming fasciculi. Occasionally there were found, mixed with the spermatozoa, active molecules, or large transparent cells (fig. D), which sometimes contained other cells, or granular cells (fig. B).

The tongue-shaped gland almost invariably presented globules of all sizes (fig. D), together with a few rounded nucleated cells, the globules being rendered opaque and granular by acetic acid. In one instance the globules were of a uniform size, and soluble in acetic acid.

The *divertikel*.—At the base of the tongue-shaped gland the epididymis appears to double upon itself, so as to form a complicated organ, which has been termed the "divertikel." It is tolerably certain that this forms the only connection between the epididymis and the oviduct; but the connection could not be clearly traced. Injections of mercury passed readily along the oviduct, but would not penetrate into the epididymis. Keferstein and Ehlers ('Köl. Zeitsch.,' vol. x, 1860, p. 269) are of opinion that the impregnation of the ova takes place in the divertikel; and this seems the more probable, as we sometimes find the eggs, covered with shells of carbonate of lime, in the upper part of the oviduct. The oviduct generally contained transparent globules of various sizes, some being in groups; occasionally, there were cells containing granular matter; or molecules, which had a tendency to run into chains (fig. E); or a few straight spermatozoa. In the *H. aspersa*, mentioned above, which was taken whilst laying its eggs, the oviduct was distended with eggs, which had calcareous shells. In *H. pomatia* a distinct coat of irregularly interlaced muscular fibres could be traced.

The lower or non-sacculated portion of the oviduct had elongated, whip-like epithelial cells, in which, in some instances, oval nuclei could be traced. The glandular portion of the oviduct consisted of cæca, lined with a coarsely granular epithelium, which assumed various forms, and was rendered transparent and displaced by acetic acid. Sometimes the cæca contained fine granular matter, with oblong refracting bodies.

The spermatheca was lined with coarse, elongated epithelial cells, which, in some cases, were produced into whip-like cilia. Spermatozoa were only sometimes to be seen. In one individual, which had just deposited its eggs, no spermatozoa were found in the spermatheca itself, but there was a mass of them in its duct. In the spermatheca of the individual surprised whilst laying its eggs there were a considerable number of actively moving animalcules, of a fish-like

form, and terminating posteriorly in a short filament, by which their swimming movement was mainly effected; the other extremity was blunt, and the body, which was considerably longer than the filamentous tail, contained numerous minute granules, and appeared somewhat flattened. These creatures moved very actively, and to a considerable distance, swimming about and gliding among the detached portions of epithelium with great celerity. They bore not the most distant resemblance to the spermatozoa contained in the ovotestis, nor were they at all like the detached particles of columnar epithelium found elsewhere. They were immediately dissolved by acetic acid, leaving a granular amorphous residuum. Gratiolet ('Journ. de Conch.,' vol. i, 1850, p. 116) states that the spermatozoa undergo a metamorphosis; and that the different forms met with in the spermatheca, and which are generally spoken of as animalcules, are really altered spermatozoa. Other writers have failed to trace this metamorphosis. The additional tube of the spermatheca, when examined in individuals immediately after copulation, contained the spermatophore; at other times it contained free spermatozoa or animalcular bodies, and sometimes only detached epithelial cells.

The multifid vesicles were lined with coarse granular epithelial cells, having large nuclei, and contained granules, which had a tendency to run into chains, and large transparent cells, in which other cells might be seen in different stages of growth.

The frequent absence of the dart from its sac has been already noticed. It is worthy of remark, that the darts received from another individual are very commonly found at the base of the tongue-shaped gland, and when so found are discoloured and partially destroyed.

On a New Species *of* Microscopic Animals.

By T. G. Tatem, Esq.

(Read December 11th, 1867.)

The marine form of Epistylis represented in Pl. VI, fig. 5, is sufficiently subversive of the statement that Epistylideæ "are found exclusively in pure water on aquatic plants or animals" ('Pritchard's Infusoria,' p. 589). It may, however, possibly prove to be merely a fresh-water form, modified by its marine

habitat. I strongly incline to that belief, and am to a certain extent confirmed in it by the fact of a Basticella (unmistakably *B. convallaria*), considered as exclusively a fresh-water infusorium, being the constant companion of this Epistylis, and both sufficiently abundant on filamentous algæ in the rock-pools of our south-eastern coast. Until its specific identity with some one of our fresh-water Epistylideæ is certainly determined, it may be provisionally named *Epistylis marinus*.

I. *Epistylis marinus* (Fig. 6).—The zooids, never more than two, are small, $\frac{1}{400}$, pyriform, colourless; vacuoles numerous; main stem robust; branchlets comparatively slender, smooth. On filamentous algæ.

II. *Epistylis ovalis*, n. sp. (Fig. 7).—Zooids two, small, $\frac{1}{450}$, colourless, oval, with a contracted raised margin or lip; main stem and branchlets long, slender, and of equal thickness. Very rare. On Anachasis.

III. *Epistylis umbellatus*, n. sp. (Fig. 5).—It is seldom indeed that so perfect an example of this elegant form of Epistylis as that figured is met with; commonly the stalk, with some eight or sixteen zooids, more commonly the bare stalk, is alone obtainable. So far as I am yet aware, it is found in one ditch only, near the wire mills on the Kennet river, near this town (Reading). The zooids, which easily become detached, are minute, oval, colourless; main stem very long, slender, dividing into four branchlets, which again subdivide into four each, in an umbellate manner, smooth, and of a light horn colour.

IV. *Cænomorpha convolutas*, n. sp. (Fig 1).—Whether the creature I figure is a more advanced stage of the *Cænomorpha medusula* described at p. 597 of 'Pritchard's Infusoria,' a new species of Cænomorpha, or the type of a new genus, I leave to other and authoritative decision. Certainly it differs widely from the only known species of Cænomorpha.

The body is colourless, smooth, conical, with the apex somewhat curved downwards, its general outline being that of a Phrygian cap, fringed at the edge with a closely set row of long cilia. Twelve to twenty long and stout setæ spring from the under side, and these enable the animal to rest upon and creep over the surface of the weeds. One large vacuole has been observed, but no contractile vesicle. The tail, which has a swollen base, encircled by cilia, is not centrical; it is long, tapering to a fine point, and slightly curved upwards, sometimes, but not commonly, bifid. The vortex raised by ciliary action is considerable, the current flowing through the channel on the under side and circulating around the base;

No distinct oral aperture has been made out. The creature is excessively active in its movements, darting through the water with great velocity, resting or creeping, however, from time to time, on any weed or flocculent matter the cage may contain.

I have in vain endeavoured to make out the life history of this interesting infusorium.

On one occasion, in early spring, I met with a little creature, in some numbers, which I believed, though I do not assert it, to be the early form, obtained in the same pools and ditches which, later in the year, abounded with the perfect animal of that which I have ventured to call a *Cœnomorpha*, and to append to it the specific name of *convoluta*.

On a Microscopic Ferment *found in* Red French Wine.

By Henry J. Slack, F.G.S., Sec.R.M.S.

(Read December 11th, 1867.)

In 'Comptes Rendus' for the 18th January, 1864, will be found one of M. Pasteur's papers, entitled "Etudes sur les Vins," accompanied by a plate showing the character of fifteen kinds of ferments as exhibited by the microscope. The third of these illustrations represents small rounded and ovoid cells, some of the latter being pointed at one end. They are arranged in groups of from two or three to seven or eight cells, and attached to some of the larger ones are extremely small ones, apparently growing from them. Fig. 2 in his cuts represents more elongated cells, with a tendency to a branched arrangement.

In the text, M. Pasteur says that, if these two kinds of cells only are seen in wine, the *Mycoderma vini* or *fleurs du vin* only is developed. He describes this plant as consisting of globular cells or joints, more or less elongated, and varying in diameter from 0·002 mm. to 0·006 mm., and is propagated by budding.

These ferments, he states, do not injure the wine, but in some cases improve it, and are essential to the good maturition (*bonne confection*) of white wines. By causing them to grow artificially, he obtained a "portion of the *bouquet*" belonging to wines of this description.

It may also be observed that M. Pasteur figures the *Mycoderma aceti*, as found in wines of the Jura that had turned sour, much like strings of minute spores of the common blue mould, radiating from a dense central mass of similar cells. He says that, so long as the *Mycoderma vini* finds plenty of nourishment, its growth tends to prevent that of *M. aceti;* but as soon as nourishment becomes deficient, the

latter ferment is formed at its expense. He adds, "red wines commonly produce only the *Mycoderma vini*, because this plant multiplies with the greatest facility in wines which contain most nitrogenous and extractive matter."

In the beginning of November the writer opened a bottle of so-called "light claret," which he believes to consist of a mixture of a strong red wine from the South of France with a thinner white wine from some neighbouring locality. Mixtures of this sort, if properly made of sound wines, are not objectionable in point of flavour, and there is no reason to suppose them unwholesome. The wine in question was a good specimen of its kind, and nothing particular had been observed in bottles previously tapped. In this case, however, upon pouring out a quantity in a tumbler, there soon floated to the top, and adhered round the sides of the glass, a reddish matter looking much like the powder of a decayed cork. Microscopical examination with a power of 240 showed a prodigious number of small cells, which, under this magnification, looked pretty much alike.

Powers of from 900 to 1400, obtained with Messrs. Beck's $\frac{1}{50}$th objective, enabled the form and structure of the cells to be distinctly seen. It was then found that they varied in size and shape much more than was apparent when

Fig. 1.

larger powers were employed (Fig. 1), and many cells that had appeared simple were discovered to be jointed. The majority of the cells were ovoid, and jointed at one or both ends. Small cells were, in many cases, attached to larger cells, as if growing out of them, and a few very short mycelium threads were mingled with the cells. Amongst the largest of these formations were triple groups, consisting of a small round cell, and a larger round one, surmounted

by an elongated pointed cell. These, in their largest transverse diameter, measured about 1-7000″, and about double that length. The cells all contained minute dots of whitish matter.

Some of the cells, taken up on a knife, were placed in a solution of moist sugar. In a few days a smell of butyric acid became very noticeable. This increased so as to be exceedingly powerful, and mingled with it a nauseous scent of other and unknown substances was observed. A portion of the sugar was transformed into a slimy, ropy mass. Microscopic examination of the fluid and of the ropy mass disclosed only a few cells of minute size, and no bacterium bodies, like those described by M. Pasteur, which are sometimes associated with the butyric fermentation. If any such bodies were present, they were certainly not in quantities proportioned to the vigour with which the butyric fermentation went on; and that fermentation seemed rather to be a purely chemical action, excited, perhaps, by the decomposition of some of the cells, than an action correlative with the growth of any organisms.

While this process was going on, an open tumbler, containing the wine and cells, was standing in the same place, and soon exhibited patches of mould, which in due time became continuous, and were covered with myriads of *Penicilium glaucum* spores.

The wine left in the bottle—rather more than half full and corked—did not turn noticeably sour, and no mould appeared upon its surface. A little of this wine was mixed with a solution of treacle, in a wide-mouthed bottle, placed on a warm shelf in a greenhouse, and covered over with a garden-pot to keep out the light. A thick crop of blue mould soon appeared, covering up the surface, but at the end of three weeks the fluid was only slightly acid, as manifested by a feeble action on litmus paper.

The non-formation of butyric acid in this case, and the formation of that substance in the previous experiment, would seem to be accounted for by difference in the nutriment supplied to the cells, and in the temperature to which they were exposed When the butyric acid was formed, no blue mould appeared; and when the blue mould was developed, no butyric acid could be detected. It is obvious that the experiments are far from sufficient to explain the nature of the different actions and results, but they serve to indicate a useful direction for research.

In a few weeks, the contents of the bottle in which the butyric acid was developed underwent a spontaneous change.

The butyric and other nauseous odours gradually lessened in intensity, and just before disappearing, were accompanied by distinct, though faint, smell of some ether—a fact which may be connected with the function, ascribed by M. Pasteur to his *Mycoderma vini* cells, of assisting to develop the *bouquet* of white wine.

When the smell of butyric acid and that of the unknown œnanthic ether had disappeared, the liquid remained odourless for a few days, and mycelium threads, together with cells, chiefly ovoid, became abundant in the ropy mass (Fig. 2). Two thirds of the clear fluid was poured off, and

Fig. 2.

replaced by a weak solution of moist sugar. On this the mycelium threads and their cells now operated, the odour of fresh vinegar became apparent, and the liquid acted powerfully in reddening blue litmus paper.

Chemists obtain butyric acid by the process of Pelouze and Gélis. A solution of sugar is excited to fermentation by mixing it with poor cheese. Lactic acid is formed, and unites with lime, which is added in the form of chalk. The lactate of lime then undergoes a change, carbonic acid and hydrogen are evolved, and butyrate of lime remains. The butyrate of

lime is mixed with dilute hydrochloric acid, and the butyric acid distilled off.

The nitrogenous matter of the *Mycoderma vini* cells probably acted in the experiment above described just as the casein of the cheese operates in the process of Pelouze and Gélis; but whether the butyric acid disappeared by simple evaporation, or by chemical action, is not evident. Professor Miller states, in his 'Elements of Chemistry,' that butyric acid volatilizes at ordinary temperatures, but a chemical change probably occurred.

Our great authority upon Fungi, the Rev. M. J. Berkeley, and Mr. Hoffman, of Margate, raised *penicilium* from insulated cells of yeast;* and as *penicilium* has been raised in the experiments just detailed from the *Mycoderma vini* of M. Pasteur, it would appear that the cells of that organism belong to one of the many forms which the yeast plant is able to assume.

Bivalved Entomostraca, Recent *and* Fossil.

By Prof. T. Rupert Jones, F.G.S.

(Read January 8th, 1868.)

Ever since naturalists have clearly seen that the many different layers or beds of stone, clay, and sand, of which the earth's surface is composed, were formed by the deposits of mud, silt, and shingle of old oceans, not by any mysterious inexplicable agglomeration of shapeless matter, they have not been content with observing the extent, the thickness, and the general characters of each bed of stone; but they have searched diligently for fossils, both large and small—that is, the petrified remains of animals and plants preserved in those old sea-deposits. As the naked eye cannot sufficiently distinguish all the peculiarities of the grains of sand and minute crystals of carbonate of lime, of which a great part of these rocks and stones are composed, so also do we require a lens or a microscope to see in a clay or a limestone all the particles that have originally belonged to animal structures. These organic particles are not always fragments and atoms of bones, of corals, or of shells, but very often are perfect little organisms themselves—perfect shells, perfect cases and coatings of minute animals, or perfect frameworks of microscopic plants.

* See article "Yeast," in 'Black's Cyclopædia of Agriculture.'

Whether we crumble down a friable freestone, such as the Bath stone or many of the Oolites of the Midland Counties—whether we powder a piece of Chalk, or reduce a piece of Lias or other clay in water, we shall find abundant well-preserved relics of ancient *Microzoa* in the dried and sifted dust. If we take a piece of limestone, whether from Dudley, Matlock, or Westmoreland, or go abroad for our specimens to any part of the world, we shall find in polished slices of the limestone more or less distinct evidences of perfect little shells of peculiar forms, requiring a strong microscope for their elucidation.

Among these microscopic fossils are some that play a more important part than others in the making up of the stony masses of many parts of our own country and of other lands. There are in particular two kinds of very frequent occurrence in clays, freestones, limerocks, marbles, chalk, &c., namely, *minute Crustacean animals*, and another set of Microzoa called *Foraminifera*. Of each of these kinds there are innumerable individuals living at the present day. These tiny creatures are as easily to be found in the living state as in the fossil condition; they have had great books written about them; and they not only afford much instruction to naturalists who study their structures and observe their habits, but they can be a source of much interest to any one who has an aquarium —the now frequent ornament of our parlours.

On this occasion I have to explain the nature of the microscopic Bivalved Crustaceans, to allude to their ways of life, and to draw attention to some of the facts connected with their being found fossilised in clays and stones.

The common Crab and Lobster are important members of the Crustacean group of Animals; so also are Shrimps, Prawns, Sandhoppers, Woodlice, the King-crab of the Moluccas, and many others, which are only noticed by the naturalist and seen in museums.

A characteristic feature of the Crustaceans is their jointed structure (placing them among the *Articulata* or *Arthropoda*), and their being for the most part coated with a hard, tough armour—the part that covers the front of the body being usually formed of a large plate or buckler (called the Carapace or Cephalothorax), and the rest consisting of ring-like segments.

The Shell (or Test) of the Lobster well illustrates this. In the Crab, however, the body is more shrunk up, as it were, beneath the Carapace, which is widened and enlarged, whilst the jointed tail-piece is very small and folded neatly underneath. The organs in the Crab are, as it is said,

concentrated; and the traces of the many ring-joints (or "somites") of which the Crustacean Animal is typically or theoretically constructed are nearly lost to sight. Indeed, if we trace the modifications of structure from one Crustacean to another—from the many-segmented Brine-shrimp to the more definitely jointed Woodlouse and Sandhopper, almost equally ringed throughout the length of their bodies—and through Squills and Shrimps with their carapace in front and their armoured tail behind, and the *Anomoura* or short-tailed members of the Lobster Tribe, until we get to the Crabs, with scarcely any tail at all, we follow, as it were, the footsteps of Nature in her advance from the lower and simpler structures, with their many times repeated parts and organs, to the higher, more concentrated, more complicated, more specialised, and, in one sense, more perfect type of animal structure.

We see the carapace flat in the Crab; in the Lobster it is folded down on either side, and so we have it in many other species; but this folding is carried a step further in some groups, the two halves being quite separate at the back, along the central line that is well marked in the Lobster, and becoming the two valves of a two-sided carapace, resembling that of a common Bivalved Mollusc.

This bivalved structure is not met with among the larger Crustacea, but only in the smaller and frequently microscopic forms. These are members of the group known by the general term "Water-fleas," or *Entomostraca* ("shelled insects"). Some live in the sea, some in ponds and rivers. They exist in countless numbers. Like the Sandhoppers, Shrimps, Lobsters, &c., they assist in the health-economy of the watery world; they are scavengers, using up all dead matters.

The Crustaceans have been termed "the Insects of the Sea," and well they may, for they not only take the place of Insects, Centipedes, and Spiders in the ocean, on every shore and at nearly every depth, but they emulate the Insect-tribe in the extremes of grace and ugliness. Though they can scarcely be said to resemble the Insects in their flight, yet in their flittings to and fro they are not unlike; and in their ceaseless, unwearying crawlings the likeness holds good;—as scavengers, too, they claim brotherhood with a world of Beetles and other Insects. In this, however, as well as in the less amount of concentration of their organs, they differ from Insects—namely, the changes which the latter undergo are from one distinct stage to another, such as caterpillar, chrysalis, butterfly; but in the Crustacea we have successive moultings of the crust, with some alteration in the body,

corresponding with the growth of the individual; and though these changes are often striking (in the young state of Crabs, for instance), yet there is no break in the line of life, no dormant period, no transition from one mode of living to another, as there is in Insects.

However diversified the forms of the different kinds of Crustacea may be—however varied the number and disposition of their limbs, yet this great group have, with few exceptions, their articulated framework as a feature in common; and if that be wanting, still (according to Huxley) the uniformly similar, six-limbed, and Nauplius-like form in which so many members of the lower groups of Crustacea begin their existence, furnishes a strong connecting link among them.

The diversity of organs among the Crustacea is almost endless; what serves as jaws in one division are legs in another; the antennæ in one may be organs of sense, in another of locomotion or of prehension: then there are thoracic branchiæ in some (Decapods), sac-like branchial appendages in others (Tetradecapods); whilst the Entomostraca rarely have any true branchiæ, the surface of either some part or of the whole of the body serving for aëration.

In the Crabs, which present the condition of highest centralisation for the Crustacea, the three front segmental elements are coalesced and modified as the organs of feeling, sight, and hearing; the next six supply the mandibles, maxillæ, and palpi for the mouth; five are devoted to the organs of locomotion and prehension; and the remainder are lost in the abbreviated abdomen or tail-piece. In the other Decapoda (with ten limbs) also, such as Lobsters, &c., *nine* segments and their pairs of appendages are thus concentrated into the organs of sense and the mouth. In the Tetradecapoda (with fourteen limbs), such as the Woodlouse, &c., only *seven* segments are concentrated for these cephalic organs. In the Entomostraca, only *six* thus coalesce for the senses and mouth in the *Cyclops* group, only *five* in the *Daphnia* and *Caligus*, and only *four* in *Limulus*.

The essential points in the framework of the body of an Entomostracan of low organization, and in the arrangement of the organs, are well seen in the Brine-shrimp (*Artemia*). Here the body has numerous articulations or segmented portions. The head-part takes up four or five coalesced somites, bearing the antennæ, eyes, and masticatory organs; eleven pairs of natatory and branchial limbs follow on eleven segments; the next two joints or rings have their own modified appendages; seven segments succeed, without appendages,

except that the last ends with the caudal flaps (post-abdomen or telson).

Others also of these lower Crustacea, or Phyllopoda (whether bivalved or not), have more than twenty segmented parts in their body; but of the twenty theoretical typical somites or segments (twenty-one,* including the telson) characteristic of a well-developed Crustacean, several of the hindmost are absent in most of the Bivalved Entomostraca; and this curtailed form is wholly enveloped in the two more or less closely fitting carapace-valves of the cephalothorax.

Thus in the Phyllopodous *Limnadia*, after the front part of the body, bearing the antennæ, eyes, and mandibles, succeed twenty-two pairs of branchial limbs, more or less developed, followed by the post-abdomen. Locomotion is here effected by the antennæ and post-abdomen. In the Cladocerous (Daphnioid) and Ostracodous (Cyproid) groups, however, of the Entomostraca, the antennæ, eyes, mandibles, and maxillæ, two to six pairs of feet (with branchial appendages attached to some of them), a short abdomen, and a strong, hooked post-abdomen, are the chief features; so in these Bivalved forms, instead of the numerous branchial laminæ of the Phyllopods, we have a few pairs of locomotive organs with their branchial appendages.

The disposition of the organs in various orders, families, and genera, may be studied in detail in the works of Baird, Dana, Zenker, Lilljeborg, Fischer, Grube, Sars, Norman, Brady, and others. For the family and generic characters of the *Ostracoda*, see G. S. Brady's memoir in the 'Intellectual Observer' for September, 1867; and for the specific characters of many of the *Cladocera*, see Norman and Brady's memoir on the *Bosminidæ*, &c., in the 'Nat. Hist. Trans. Northumberland and Durham,' 1867.

The Bivalved Entomostraca differ among themselves not only with respect to the arrangement and characters of the organs of sense, mastication, locomotion, and aëration, but also very markedly in the shape and structure of their carapace-valves.

In *Apus*, one of the Phyllopods, the carapace (or shell covering the cephalothorax) is nearly flat and shield-like, but ridged along the middle. In *Nebalia*, another Phyllopod, the carapace is folded down, as it were, on either side of the animal; the abdomen extends beyond it behind, the legs below, and the antennæ in front, with a small, arched,

* The twenty-one theoretical somites are thus allocated by some naturalists:—seven to the head or cephalon, seven to the thorax or pereion, and seven to the abdomen or pleon.

moveable projection above the eyes. In the *Cladocera* (*Daphnia*, &c.) the carapace is still more flatly folded down, with a bend along the dorsal line; and the whole of the body is included within it, except that the antennæ (as swimming limbs) protrude at the head from lateral notches, which give to the front of the carapace a hood-like or quaintly beaked shape.

In other Bivalved Entomostraca the two sides of the folded carapace are quite distinct, forming separate valves, but united in life along their dorsal margins by either a simple membranous attachment (as in *Estheria*, &c.), or by a more complex system of ridge and furrow, or teeth and sockets (as in the *Cyproidea*).

In outline the carapaces of *Cladocera* range from orbicular to oblong, with varying contours. They are horny or chitinous, thin, usually transparent, and ornamented often with some reticulate pattern, having reference to the hexagonal cell-system of the typical crustacean test, or the network resolves itself into delicate bands and furrows by the greater development of one set of mesh-lines than another. This carapace is periodically moulted and renewed; but occasionally it is retained, and one layer succeeds on the inside and at the outer edge of another until the valve is marked with several concentric boundary-lines of the periodic stages of growth. Mr. Norman points out that this feature, normal in *Menosphilus tenuirostris*, is occasional in *Lynceus elongatus*; see 'Nat. Hist. Trans. Northumberland and Durham,' 1867, p. 53. It is also normal in the *Limnadiadæ*, which retain their valves, whilst they cast only a chitinous skeleton or framework of the body.

Fossil carapaces of *Cladocera* have not been recognised, their extreme tenuity probably being neither favorable for their preservation nor, if preserved, to their detection in the fossil state.

The Bivalved Phyllopods, such as *Limnadia*, *Estheria*, and *Limnetis*, are larger than the *Cladocera*, and their valves are usually thicker and stronger. In shape round, oval, or oblong, they often resemble the shells of Conchifera or Bivalved Molluscs, and have been mistaken for them when living, and much more frequently in the fossil condition. The presence of a straight hinge-line, of umbones, and of concentric lines of growth, are special features in which they more or less imitate the Conchifera, such as *Avicula*, *Tellina*, *Pisidium*, &c. *Estheria donaciformis* came to the British Museum as a *Nucula*; but Dr. Baird recognised its crustacean characters, disguised as they are by the molluscan shape.

Estheria minuta long passed as a little shell among geologists until Prof. Quekett's microscope detected the hexagonal cell-tissue of the Crustacean in fragments of the fossil: see my 'Monograph of the Fossil Estheriæ' (Palæontographical Society), 1862, pages 3, 11, &c.

Very different kinds of carapace-valves belong to the *Ostracoda*. A synopsis of the recent British forms of this great group, carefully drawn up and illustrated by Mr. G. S. Brady in the 'Intellectual Observer' for September, 1867, gives us a good general view of these very interesting Bivalved Entomostraca, amongst which are (excepting some of the Copepoda and Cladocera) the most common of the marine and freshwater forms, both recent and fossil. Thus—

Cypridæ.—*Cypris; Cypridopsis; Paracypris; Notodromas; Candona; Pontocypris; Bairdia; Macrocypris.*

Cytheridæ.—*Cythere* (and *Cythereis*); *Limnocythere; Cytheridea* (and *Cyprideis*); *Cytheropsis* (to be changed to "*Eucythere*"); *Hyobates; Loxoconcha* (= *Normania*); *Xestoleberis; Cytherura; Cytheropteron; Bythocythere; Pseudocythere; Cytherideis; Sclerochilus; Paradoxostoma.*

Cypridinidæ.—(*Cypridina*;) *Philomedes; Cylindoleberis; Bradycinetus.*

Conchœciadæ.—*Conchœcia.*

Polycopidæ.—*Polycope.*

Cytherellidæ.—*Cytherella.*

The valves of the *Cypridæ* (Brady) are small, usually either kidney-shaped, oblong, or boat-shaped, smooth or bearing only faint punctation and delicate setæ, and rarely thickened on the hinge-margins. The *Cytheridæ*, on the other hand, though often smooth, have frequently thick and highly ornamented valves, coarsely or neatly pitted, sculptured with fret-work (more or less reticulate), or bristling with spines and spikes. Either ovate or oblong in many shapes, they have usually thick hinge-margins, with furrows and sockets for bars and teeth. The other families mentioned have smooth valves; those of *Cypridina* are large, thick, and convex, mostly round or oval, and are marked with an antero-ventral notch *Conchœcia* has an oblong, and *Polycope* a subspherical shell; both thin. *Cytherella* has oblong, compressed, thick valves, usually smooth, one fitting into the other somewhat like the lid of a wooden snuff-box.

Of the *Ostracoda* very many are found fossil, such as belonged to fresh waters, to brackish waters, and to the sea, in great variety. Münster, Roemer, Reuss, De Koninck, Bosquet, Bornemann, and others have described many species

from the strata of Germany, France, Belgium, &c.; and at home M'Coy, Salter, Kirkby, Holl, G. S. Brady, and myself are among those who have treated of such as have been met with in the British Isles; but a large number still remained undescribed.

Amongst the fossil specimens are several that cannot be readily co-ordinated with the groupings made out of the existing forms, as may be expected both by naturalists who are accustomed to look on the existing races as successional representatives of older forms, and by those who may regard successive faunæ as creational replacements.

Among such fossil forms are many from the older ("Palæozoic") strata; but even for these existing representatives occasionally turn up, such as Brady's *Heterodesmus*, lately brought from the Japanese seas, which has apparently a close affinity with M'Coy's *Entomoconchus* of the Mountain-limestone. Some, indeed, of the old forms are scarcely distinguishable, as far as the valves are concerned, from their modern representatives; for instance, *Cypridina primæva* (M'Coy, sp.) of the same old limestone, and its associates *Cyprella* and *Cypridella*, present in the various valves of their multiform species gradations among themselves, and an easy passage into *Cypridina* itself. Others among the ancient faunæ possess two or more of the characteristics that are now divided amongst the several members of a group; thus the carapace of the *Leperditia* of the Silurian period has resemblances in outline to members of the Limnadiadæ, Cypridininæ, and Cypridæ; in muscle-spot to the first two; in vascular markings to the first and to the Apodidæ; in the place of the eyes to the second and fourth; and in the eye-tubercles to the third and fourth. Altogether *Leperditia*, and its palæozoic congeners *Isochilina*, *Entomis*, *Primitia*, *Beyrichia*, and *Kirkbya*, seem to be more nearly within the alliance of the *Limnadiadæ* than of the others. Nevertheless, in these as well as in other groups of Bivalved Entomostraca, we have always to be careful in assigning special value to differences of outline, ornament, and structure, because it is not unusual, among these little Crustacea, to find that similar shells may belong to different genera, when we examine them alive; and on the other hand very closely allied species may have dissimilar valves.

As a general rule the fossil Entomostraca of freshwater, brackish, and marine strata, respectively, correspond in family and generic characters to species found in such waters at the present day; and therefore the geologist often finds his supposition as to the origin of a set of strata confirmed by the

presence of this or that kind of Entomostraca; and in some instances thin intercalated bands of freshwater or of estuarine deposits, amongst marine strata, can be indicated by the presence of *Estheriæ*, which in past, as in present, times appear to have avoided sea-water, though living abundantly in salt-marshes and lagoons. See the 'Monograph of Fossil Estheriæ,' 1862.

Thus, also, Mr. G. S. Brady observes ('Intellectual Observer,' 1867, p. 111), in noticing the geological interest of Entomostraca, "My belief is, therefore, that those strata which exhibit such very abundant and closely packed remains of the smaller *Cypridæ* and *Cytheridæ* have most likely been formed in shallow, brackish lagoons, or at the mouths and deltas of rivers. The species of Ostracoda which I have found in these situations are *Cytheridea torosa* (Jones), *Cythere pellucida*, Baird, and *Loxoconcha elliptica*, Brady; while in water a little further from the saline influence, but still slightly partaking of it, it is not uncommon to meet with *Cypris salina*, Brady, and *Cypridopsis aculeata*, Lilljeborg, as well as Entomostraca belonging to other orders."

The Entomostraca act pre-eminently as scavengers in both salt and fresh waters. Most of the groups (as Copepods, Ostracods, and Phyllopods) comprise both marine and fresh-water species; but the *Cladocera* are confined to fresh water. The excessive swarming of the pink *Daphnia* or Water-flea has occasionally reddened pond-water so strongly as to have seemed supernatural to our ancestors, and to have produced terror, as an evil omen, among the ignorant. Amongst the British *Ostracoda*, *Cypris*, *Cyprodopsis*, *Notodromas*, and *Candona*, are inhabitants of lakes, ponds, ditches, streams, and rivers; and they can be readily obtained and conveniently kept and studied in the aquarium. *Paracypris*, *Pontocypris*, *Bairdia*, and *Macrocypris*, are marine members of Mr. Brady's group "Cypridæ." Excepting the fresh-water *Limnocythere*, all the *Cytheridæ* are marine, *Cytheridea* and *Loxoconcha* having also a taste for brackish water. These salt-water species of the Bivalved Entomostraca are distributed in deep and shallow seas, in pools on the beach between tides, in lagoons and back-waters, and in the brackish water of estuaries and salt-marshes. The 'Trans. Zoolog. Soc.,' 1867, contains a memoir, by Mr. G. S. Brady, descriptive of some new forms of Ostracoda, in which we find some "habitats" referred to as being in "shallow water," and others at 14, 17, 30, 43, 60–70, 223, 360, 470, and even 2050 fathoms.

The *Cypridæ*, having plumose "antennæ," or natatory

limbs, possess a greater or less power of swimming, *Candona* being a marked exception. On the other hand, the anterior locomotive limbs of the *Cytheridæ* have usually short setæ and hook-like spines, instead of bunches of long, delicate filaments; and consequently these animals crawl about on the weeds, shells, and mud, and few among them can swim at all.

The *Cypridinidæ* are mostly free-swimming, oceanic forms. Mr. Brady observes that "some of the members of this family have very slight swimming powers, and live chiefly amongst mud; others are very agile swimmers, and are often taken in the towing-net—more especially at night—near the surface of the sea. They seem, indeed, to contribute very materially to the production of the wonderful phosphorescence of the tropical seas" ('Intellectual Observer,' 1867, p. 115).

The removal of dead animal matter is easily accomplished by Entomostraca and other small Crustacea; and, as the Emmets and their little fellow-labourers pick bare the bones of large land animals, so these minute creatures of the water use up the dead bodies of animals in the ocean, the lakes, and rivers, foraging for the dead zoophyte, and swarming over the lifeless mass of mollusc, annelid, and star-fish, and taking their share of the dead Fish that had lived by eating their fellows,* and of the dead Whale that had strained from the water myriads of their congeners for his daily food. When the sailors, in one of Parry's Voyages, hung their salt beef over the ship's side in the water for a while, it soon disappeared under the combined attack of these little devourers; and if a fish be put in a perforated canister in a suitable stream or pond for a couple of days, its skeleton will be prepared by the tiny Crustaceans. Just as Mr. Charles Moore has found in the Lias of Somersetshire, the fossil Reptiles overlain by a swarm of Ammonites, buried with the half-eaten carcase in the mud, so the fossil remains of Fishes (as noticed by Phillips, Binfield, myself, and others) are often and often found imbedded with innumerable carapace-valves of the Entomostracous scavengers in mud-beds of all ages, especially the Carboniferous, Wealden, and Tertiary clays); nor are Entomostraca wanting among the bones of fish and reptile in the Lias above alluded to.

Thus also we have seen a crowd of *Cyprides* and *Candonæ* cleaning out the shell of a *Paludina* or a *Linnæus* in an aquarium; and in the fossil state we know that valves of

* See Dr. Baird's "Notes on the Food of some Fresh-water Fishes, more particularly the Vandace and Trout." 1857.

Entomostraca are sometimes associated in the shells of Molluscs. Thus Mr. J. W. Kirkby says ('Trans. Tyneside Nat. Field-Club,' vol. iv, 1859), "The convex valve of a Conchifer appears to have been a popular place of resort with the *Bairdiæ*, for out of one I procured some dozens of individuals."

The rapid increase of some kinds of Entomostraca, and the tenacity of life possessed by the eggs, are circumstances that have attracted the attention of naturalists. The almost sudden appearance of *Apus* and of *Estheria* in great numbers in ditches, and even in cart-ruts, after heavy summer rains, in Germany and France, have been particularly noted. Here allusion need be made to these facts only to remind the reader that the dried mud of ponds will nearly always be found to contain the still vital eggs of various species of Entomostraca; and if small portions be sent home from abroad, and placed in pure water, the species belonging to the original pond may be produced under the eye of the naturalist and properly recorded. Thus, Mr. Henry Denny and Dr. Baird had the pleasure of raising in England, from dried mud sent by Dr. Atkinson from Jerusalem, several species of Entomostraca new to science. (See 'Ann. Nat. Hist.' for October, 1859, and September, 1861.

Flourishing, then, in every water-area, fresh or salt, deep or shallow, running or still,—possessing strong powers of vitality and reproduction, and furnished with relatively hard or tough coverings, calcareous or corneo-calcareous in substance, these minute but innumerable Entomostraca have left their valves, either as the exuviæ of periodical castings, or as the lasting remains of hosts of animalcules buried in the tide-shifted silt or the mud and sand of the freshet, to be fossilized in laminated clays, hardened mud-stones, and solid rocks of limestone.

In the extremely old "Silurian" strata we find abundant specimens of *Primitia*, *Beyrichia*, *Leperditia*, and *Entomis*, apparently related to the Phyllopods, and always associated with marine fossils. In the "Devonian" beds of marine origin we find *Entomis*, &c.; and in the fresh-water beds of the same period there is an *Estheria*, both in Scotland and Russia. The "Carboniferous" formations next succeed, and contain a host of Bivalved Entomostraca, many of them not yet described. *Cypridina* is well represented in these old strata with *Entomoconchus* (before alluded to); *Leperditia* lived on, with *Beyrichia;* and *Kirkbya* flourished with *Cythere* and *Bairdia*. In the fresh-water or estuarine bands *Estheria* occurs in several species, and *Cypris* or *Candona* is present

also. The persistence of these genera from so old a time to the present is what is expected of such relatively low forms of life; wide geographical extension and long-continuance belonging to such creatures as have not been highly specialised. In the "Permian" formations ("Magnesian Limestone" of Durham and other strata) *Bairdia, Cythere,* and *Kirkbya* play an important part. In the "Trias" or "New Red Sandstone" we find *Estheria,* where marine conditions failed and fresh water had an influence, not only in Europe, but in India and America. (See my 'Monograph on Fossil Estheriæ,' 1862.) The Entomostraca of the "Lias" and the "Oolites" are not few, though not well known. In the "Purbeck" and "Wealden" beds they are better known. Masses of Purbeck building stone are wholly composed of the valves, and some of the Weald clays split like paper along the layers of shed valves of *Cypridea:* nor are *Estheriæ* wanting in these old freshwater beds. The "Gault" and "Chalk" are full of *Cythere, Bairdia,* and other allied genera, all marine. The "London Clay," the "Bracklesham Beds," and "Barton Clay," swarm in some places with similar forms, whilst the "Woolwich Beds" below them, and the "Hampstead" and "Osborne" formations of the Isle of Wight, above, are characterised by *Candona, Cytheridea,* &c., such as love estuaries, lakes, and rivers. Lastly, for England, the "Crag" of Suffolk, and that of Bridlington, abound in marine forms.

If we had only these little fossils whereby to form an opinion of the probable conditions under which the clays, sandstones, and limestones were formed in the long past eras of this planet, we should have, in nearly every case, ample evidence of the history of each bed of mud, silt, and shell-sand, in which these minute Entomostraca can be found.

The seas of the Silurian period had their thick-shelled *Leperditiæ* and *Beyrichiæ* very distinct from their now living congeners, but linked to them by close affinities readily discoverable by the naturalist. When land was increased, in the Devonian period, the sea-coasts still abounded with marine Crustacea; and the lakes and rivers abounded with *Estheriæ,* like those of the present day. The coral-seas, which gave birth to the Derbyshire limestone, abounded with strange forms of Entomostraca. Land still extended, and miles and miles of swampy coasts and lowlands crowded with the dense vegetation of the Coal-period, and, intersected with black, muddy lagoons, offered a home for endless tribes of Entomostraca, feeding on animal and vegetable refuse—the rotting plants and shoals of fish, poisoned by the black mud

of the peaty rivers. These muds and silts, and all their buried shells, and plants, and fish, and crustaceans, sank down, and were covered up and hardened—petrified, often baked by heat, and then, pushed up again by subterranean force, reappearing at the surface as the hard, rocky base of many a new country, and forming the bed of new seas, were eaten into by the ever-working waves, worn down by periodic rains, aided by the scorching sunbeams, the splitting frost, and the incessant agency of the atmospheric gases chemically affecting the surfaces of the rock.

The sea, now occupying fresh areas, continued its great work of destruction and reparation—wearing down the shores to make up the sea-beds; and it continued to be the abode of life in its myriad forms; but they were mostly new forms. In the new deposits laid down on the upturned edges of the old strata we find Entomostraca again, similar to those of to-day, and in the lagoons and lakes of the Triassic period *Estheriæ* abounded. The varying seas, the estuaries, bays, gulfs, and oceans of the Oolitic period, when land was rising here and sinking there—the sea ever rolling under its tidal laws, and coming and going amongst the ever-shifting land—these seas, we know, swarmed with Entomostraca, amongst the world of marine creatures, and the rivers and lakes were swarming too. The land that bore the great Iguanodon and Megalosaurus—gigantic lizards wandering over the marshy grounds, just as the amphibious Hippopotami of to-day wallow along the African swamps—had its great rivers; and their deltas, like those of the Ganges and Mississippi, consisted of mudbanks and muddy lagoons, full of *Uniones*, *Paludinæ*, *Cyrenæ*, and other shell-fish, and above all with *Cypridæ* and *Estheriæ*, feeding on the dead molluscs and fish.

The Sussex marble is mainly composed of these sometimes; some beds of freestone at Swanage are wholly made up of them, and flake after flake of black clay, once mud, may easily be picked by the hand, in the Isle of Wight, in cliffs some miles extent, from beds of shale nearly two hundred feet thick, every surface being thickly coated with the shells or carapaces of these minute creatures. What durable witnesses of a long-past age!

The "Age of Reptiles" passed away, the land and its rivers went down, the sea-bed and the estuaries were coated over with new sands and clays, derived from new cliffs and new lands, washed by the untiring, enduring sea. Some parts of what is now the European area sank several hundred feet, and was covered by a deep sea, and in this were formed

successively the Greensand, Gault, and Chalk. The shores were thus gradually changed, and the new land elsewhere raised up, or remaining as islands here and there, bore new plants, new trees, and new animals; the sea also brought forth new Entomostraca, which may be easily obtained by washing the Gault clay into mud, drying and sifting it, and by washing the Chalk into powder, and examining it with a glass.*

Another great change occurred over half the world, at least; the strata that had been accumulating in gradually deepening seas, and on sinking sea-beds, were hoisted up again by subterrancan force, and a new era was inaugurated —recognised by geologists in the sands, clays, and limestones which they denominate "Tertiary." The land was diversified more than before,—more islands, more bays, more rivers, more seas; hence a greater variety of life in every shape, animal and vegetable, and not least in *Entomostraca.*

From some beds of sand and clays we get *Cytheridea Muelleri,* such as now covers the estuarine muds not far from mouths of rivers; in other beds we get *Bairdia subdeltoidea,* such as is chiefly found in deep seas and warm climates: in another stratum we get the carapaces of *Cytheres,* such as we find in the shallow water of our own coasts. Here we have evidences of the existence of different conditions of sea-bottoms, contemporaneous or successive, as the case may be, in a series of deposits now converted into clay or stone.

Elsewhere we have layers of clay or stone filled and covered with the shells of *Cyprides,* as thickly strewn as in the mud of any river now running.

Tracing these river-deposits and these sea-deposits, the Geologist traces out the ancient outlines of land and sea in the long past periods of the earth's history, of which we have no other record. But this is a record sufficient; and it teaches us, also, that not only to great things but to small, not only to monsterb easts—Iguanodons, Elephants, Whales —but to microscopic Entomostraca, is our attention to be turned if we wish to learn aright what has passed on this earth's surface, if we wish to carefully study God's creation, and to see all the evidences of perfect design and perfect adaptation that the history of successive forms of life, with their successive modifications of structure and habits, can supply.

* See some notes on the preparation of clays, sands, and chalk, for microscopical purposes, in the 'Geologist,' 1858, vol. i, p. 249.

Table of the Crustacea *; provisional, and compiled from various sources, to illustrate more especially the Groups of* Bivalved Entomostraca.

* These are known in both the recent and the fossil state.

† These are known only as fossils. Lowry's 'Chart of Fossil Crustacea,' 1865, shows admirably the range in time for all the groups, from the earliest to the present period.

CLASS. CRUSTACEA.

Subclass 1. Decapoda.* (Cancer, &c.)
2. Tetradecapoda.* (Oniscus, &c.)
3. Entomostraca.*

Order I. Gnathostomata.*

Legion 1. Lophyropoda.

Tribe 1. Cyclopoidea. (Copepoda.)

Families. Cyclopidæ, &c.

Tribe 2. Daphnoidea. (Cladocera.)

Families. Penilidæ, Daphnidæ, Bosminidæ, Lynceidæ, &c.

Tribe 3. Cyproidea.* (Ostracoda.)

Family I. Cypridæ* (*Brady*).

Genus. Cypris.*
Chlamydotheca.
Newnhamia.
Candona.*
Cypridopsis.
Paracypris.
Notodromas.
Pontocypris.*
Bairdia.*
Macrocypris.*

Family II. Cytheridæ.

Genus. Cythere.*
Limnocythere.
Cytheridea.*
Eucythere.
Ilyobates.
Loxoconcha.*
Xestoleberis.
Cytherura.*
Cytheropteron.*
Bythocythere.*
Pseudocythere.
Cytherideis.*
Sclerochilus.
Paradoxstoma.

Family III. Cypridinidæ.*
Genus. Cypridina.*
Asterope.
Philomedes.
Cylindroleberis.
Bradycinetus.
Cypridella.†
Cyprella.†
Entomis.†
Family IV. Halocypridæ.
Genus. Halocypris.*
Heterodesmus.
Entomoconchus.†
Family V. Conchœciadæ.
Genus. Conchœcia.
Family VI. Polycopidæ.
Genus. Polycope.
Family VII. Cytherellidæ.
Genus. Cytherella.*

Legion 2. Phyllopoda.
Tribe 1. Artemioidea.
Family I. Artemiadæ.
Genera. Artemia, Chirocephalus, &c.
Family II. Nebaliadæ.
Genus. Nebalia.
Hymenocaris.†
Ceratiocaris.†
Tribe 2. Apodoidea.
Family. Apodidæ.
Genus. Apus.*
Dithyrocaris.†
Tribe 3. Limnadoidea.
Family I. Limnadiadæ.
Genus. Limnadia.
Estheria.*
Limnetis.
Family II. Leperditiadæ.†
Genus. Leperditia.†
Primitia.†
Beyrichia.†
Kirkbya.†

Order II. Cormostomata.
Suborder 1. Pœcilopoda. (Caligus, &c.)
2. Pycnogonoidea. (Cyamus, &c.)
Order III. Merostomata.
Suborder 1. Eurypterida.† (Pterygotus,† Eurypterus,† &c.)
2. Xiphosura.
Genus. Belinurus.†
Prestwichia.†
Limulus.*
[Trilobita.†]
Subclass 4. Cirripedia.
5. Rotatoria.

Anniversary Meeting,

February 12th, 1868.

James Glaisher, Esq., F.R.S., President, in the Chair.

Report on the Microscopes and Cabinet of Objects.

On no previous year have we had to report so favourably as on the present; it is, therefore, with much pleasure that we present the following statement as to the number of microscopes and objects the property of the Society. First, as regards microscopes.

No. 1. Wilson's Simple Microscope, with compound body, several object-glasses, and various adjuncts. This microscope is made of silver, and is of admirable workmanship.

No. 2. Culpepper's Compound Microscope, with various object-glasses and appliances.

No. 3. Benjamin Martin's Compound Microscope, supposed to be made for King George the Third. This instrument is a marvel; and it is indeed a matter of surprise to what perfection workmanship was carried in those days; the more it is looked into, the more is the spectator struck with astonishment; and many things have since been brought out as new which were made for this instrument. There is a good description of it in our "Transactions," by Mr. Williams, late Assistant Secretary, and also in Quekett's third edition of 'The Microscope,' with a good engraving.

No. 4. Powell and Lealand's best Compound Microscope, made for the Society in 1841, with a full range of object-glasses and every needful appliance; this instrument has lately had Mr. Wenham's Binocular arrangement added.

No. 5. Andrew Ross's best Compound Microscope, made for the Society in 1841, with a full range of object-glasses, and every needful appliance.

No. 6. Smith and Beck's best Compound Microscope, made for the Society in 1841, with a few object-glasses, and some appliances; the object-glasses of this instrument are much damaged.

No. 7. A Compound Microscope, presented to the Society by the late Edwin Quekett, Esq., with one object-glass.

No. 8. Best Compound Binocular Microscope, presented to the Society by Thomas Ross, Esq., with a full range of object-glasses and every appliance. This instrument was used too much, but the generous donor has just put it into thorough repair. Mr. Ross has also presented to the Society his new 4-inch object glass.

No. 9. Baker's best Compound Binocular Microscope, with bull's-eye condensor, Webster's achromatic condensor, 3-inch, 1½-inch, and ⅔-inch object-glasses.

No. 10. Swift's Compound Binocular Microscope, with bull's-eye condensor, diaphragm, and Webster's achromatic condensor and adjusting diaphragm.

No. 11. Swift's Compound Binocular Microscope, with bull's-eye condensor and diaphragm.

The three last have been purchased from the Society's funds, and to see how they are used on Wednesday evenings is a plain proof that they were altogether needed, and have given general satisfaction.

No. 12. Browning's Micro-Spectroscope, improved to the present time, purchased out of the Society's funds.

No. 13. Wray's ⅔rds object-glass, 50° aperture, presented by the maker to the Society through the Rev. J. B. Reade.

No. 14. The Writing Machine, which gained the medal at the Great Exhibition, in 1862, is of world-wide fame. Writing has been obtained from it so small, that the whole Bible could be written twenty-two times in one square inch. This machine, the invention of William Peters, Esq., and in a great measure his own handicraft, was most generously presented to the Society through R. J. Farrants, Esq., in 1862. The value of this instrument is not sufficiently recognised by the Society, and it is hoped that our friend Mr. Farrants will kindly give his helping hand that this valuable instrument may be of real use, which can only be done by instructing others to use it.

We now possess eight microscopes, all in good working order, four of them binocular, with thirty-two object-glasses, and every appliance that can be required. It is only during this last year they have been properly looked into and re-

paired, and new instruments and new object-glasses obtained, so that the Society can really boast of having a set of instruments, object-glasses, and appliances of which they may be proud. It is to be hoped our funds will soon enable us to add more, for the attendance on Wednesday evenings is greatly increasing, and the Fellows are finding out that they have privileges and advantages of no mean order, and it will be the duty and pleasure of your Committee to render all under their care more beneficial to the Society.

Cabinet of Objects.

Number of objects in the Cabinet on February 13th, 1867		1414
1867.		
Mar. 13.	Presented to the Society by Professor H. L. Smith, of Kenyon College, Gambia, United States, 146 slides of Diatomaceæ . .	146
,, 13.	Presented by W. Ladd, Esq., seven slides of Mineral Salts	7
May 8.	Presented by Major Owen, eleven slides of the family Colymbitæ	11
,, 8.	Presented by Thomas Ross, Esq., twenty slides of Gold dust	20
Nov. 24.	Presented by Dr. Carpenter, twenty-four slides of Foraminifera	24
Dec. 12.	Presented by Thos. S. Ralfs, Esq., of Melbourne, twelve specimens of Blood-discs .	12
1868.		
Jany. 8.	Presented by Mr. Lobb, nine slides of Test objects	9
,, 8.	Presented by Dr. Wallich	1031
		2674

The objects are being entirely rearranged; the Cabinet has been altered to take them all horizontally, instead of vertically, as heretofore. A new classification is about to be adopted, which will lead to the formation of a new catalogue, and to every object being reticketed; this cannot be hurried, and, no doubt, extra assistance will be required; no time will be lost, and no trouble spared, in order to render the Cabinet of Objects in every way efficient.

The munificent donation of Dr. Wallich will receive special notice at the hands of our President.

Ellis G. Lobb.
Rich. Mestayer.

RECEIPTS.

	£	*s.*	*d.*	£	*s.*	*d.*
Cash Balance at Bank of England				230	4	10
Subscriptions received for 1858	1	1	0			
,, ,, 1859	1	1	0			
,, ,, 1860	1	1	0			
,, ,, 1861	1	1	0			
,, ,, 1862	1	1	0			
,, ,, 1863	8	8	0			
,, ,, 1864	16	16	0			
,, ,, 1865	27	6	0			
,, ,, 1866	107	2	0			
,, ,, 1867	256	4	0			
,, ,, 1868	196	7	0			
				617	8	0
Admission Fees :—						
7 Fellows at £1 1*s.*	7	7	0			
61 Fellows at £2 2*s.*	128	2	0			
				135	9	0
Compositions :—						
14 Fellows at £10 10*s.*	147	0	0			
1 Fellow at £21	21	0	0			
				168	0	0
Dividends on £1023 8*s.* 5*d.* Consols				30	3	2
Interest on £300, whilst on deposit at the Union Bank				2	3	3
Donation to Library Fund, from W. T. Suffolk				1	0	0
Sale of 'Transactions,' &c.				14	12	0
Cash				2	2	0
				£1201	2	3

ASSETS :—	£	*s.*	*d.*	£	*s.*	*d.*
Consols	860	19	10			
Ditto	162	8	7	1023	8	5
Compositions at Union Bank				168	0	0
Charter Fund Balance				143	17	0
Quekett Medal Fund :—						
India 5 per cent. Stock	67	13	7			
Cash Balance	23	6	2	90	19	9

List of Fellows :—Compounders, 90; Annual Subscribers, 353; Abroad, 1; = 444. Foreign Fellows, 4; Associates, 2; Honorary, 1; = 7.
(New Fellows elected, 74.)

February 11, 1868. W. H. INCE, *Acting Treasurer*.

PAYMENTS.

	£	*s.*	*d.*	£	*s.*	*d.*
Salary of Assistant Secretary		47	4	6		
„ Curator		7	10	0		
					54	14	6
Editors of Journal (3 quarters)		170	1	3		
Delivery and Postage of ditto		22	1	6		
					192	2	9
Delivery of President's Address					5	16	0
Rent to Christmas, and Gas					47	3	2
Paid King's College—part of Soirée Expenses		24	11	7		
Refreshments and Soirée Expenses		16	11	6		
					41	3	1
Printing					48	19	6
Stationery					12	6	3
Reporter					8	8	0
Commission paid to Collectors		22	7	0		
„ „		1	4	0		
					23	11	0
Lamp Oil, &c.					4	17	8
Ray Society—Subscription for 1867					1	1	0
Petty Expenses, Postage and Receipt Stamps					14	16	4
Fire Insurance on £800 to Nov., 1868					2	0	6
					456	19	9
Compositions of 1866 invested in £162 8*s.* 7*d.* Consols					147	0	0
„ 1867 deposited at the Union Bank					168	0	0
Furniture		70	12	3		
Library		81	5	9		
Cost of Two Binoculars		21	4	0		
Repairs to Microscopes		9	15	6		
					182	17	6
					954	17	3
Petty Cash Balance—							
With Treasurer	2	1	2				
With Assistant Secretary	2	9	6				
				4	10	8	
Cash Balance at the Bank of England (Western Branch)				241	14	4	
					246	5	0
					£1201	2	3

LIABILITIES :—

Bookbinder	£24	19	3
'Journal' for January, 1868	50	12	6
Instruments	6	12	6
Seal, &c.	16	16	9
King's College, on account of Soirée			

We, whose names are hereunto attached, have examined the Treasurer's accounts, and find that he has received the sum of £1201 2*s.* 3*d.*, and paid the sum of £954 17*s.* 3*d.*, leaving a balance to the credit of the Society at the Bank of England of £241 14*s.* 4*d.*

(Signed) CHARLES TYLER, } *Auditors.*
February 11, 1868. CHARLES STEWART, }

	£	s.	d.
Receipts per Cash-book, from 12th February, 1867, to 11th February, 1868	1515	17	3
	£1515	17	3

	£	s.	d.
Payments per Cash-book	1274	2	11
Cash Balance at the Bank of England, 11th February, 1868	241	14	4
	£1515	17	3

Balance Sheet Abstract.

	£	s.	d.
Receipts for year	1201	2	3
Deposit at the Union Bank returned	300	0	0
Tea Money collected	9	10	0
Subscriptions entered twice	5	5	0
	£1515	17	3

Per Contra.

	£	s.	d.
Payments	954	17	3
Cash on Deposit at the Union Bank	300	0	0
Subscriptions entered in error to credit twice	5	5	0
Tea Money collected, deducted from the sum £15 8s. 9d. paid out	9	10	0
Petty Cash—with the Treasurer £2 1 2			
with Assistant-Secretary 2 9 6	4	10	8
	£1274	2	11
Cash Balance at the Bank of England	241	14	4
	£1515	17	3

The President's Address *for the year* 1867-1868.

By James Glaisher, Esq., F.R.S., &c.

Gentlemen,—It gives me pleasure again to address you after you have heard the report of your treasurer, which shows the finances of our Society to be in a prosperous and good condition.

At the present time, too, we have a larger number of Fellows than at any time of the history of this Society.

We have lost some Fellows by the hand of death, and this is always a painful subject upon which we have to dwell yearly. During the past year four Fellows have been thus removed, namely, Henry Black, Henry Clark, Robert Warington, and Michael Faraday.

Professor Faraday was born at Newington, Surrey, in the year 1791, and was apprenticed to a bookseller and bookbinder, with whom he continued till 1812. At this early period of his life he showed his thirst for science, not only reading such works on science as fell in his way, but applied himself to the construction of electric and other machines. In his letter to Dr. Paris, in reference to his first introduction to Sir H. Davy, he says, "I was very fond of experiment, and averse to trade. It happened that a gentleman, a member of the Royal Institution, took me to hear some of Sir H. Davy's last lectures in Albemarle Street. I took notes, and afterwards wrote them out more fully in a quarto volume. My desire to escape from trade (which I thought vicious and selfish) and to enter into the service of science, which I imagined made its pursuers amiable and liberal, induced me at last to take the bold and simple step of writing to Sir H. Davy, expressing my wishes, and a hope that if an opportunity came in his way he would favour my views. At the same time I sent the notes I had taken at his lectures." The result of this letter was that in 1813 Faraday was admitted into the Royal Institution as Chemical Assistant to Professor Brande.

He soon became the favourite pupil and the friend of his patron, and in October, 1813, he accompanied Sir Humphrey Davy on a tour through several countries of Europe, returning to the Royal Institution in 1815, and in which he continued up to the time of his death.

In 1821 he discovered the mutual rotation of a magnetic pole and an electric current; in 1823 the discovery of the condensation of gases; in 1831 and following years the development of the induction of electric currents, and the evolution of electricity from magnetism. In 1846 he obtained the Rumford medal, and that of the Royal Society, for the establishment of the principle of definite electrolytic action, and the discovery of diamagnetism and the influence of magnetism upon light. He made known the character of oxygen, and the magnetic relations of flame and gases, in 1847.

When Mr. Fuller founded the Chair of Chemistry in the Royal Institution, in 1833, Faraday was appointed First Professor. In 1835 he received a pension from Government of £300 a year, for his important services to science. In 1836 he was appointed Scientific Adviser on Lights to the Trinity House, and was subsequently nominated to a similar post under the Board of Trade. From 1829 to 1842 he was Chemical Lecturer at the Royal Military Academy at Woolwich.

In 1823 he was made a Corresponding Member of the Academy of Sciences in Paris; in 1825 he was elected a Fellow of the Royal Society; and in 1832 the honorary degree of Doctor of the Civil Laws was conferred on him by the University of Oxford. He was a Knight of the Prussian Order of Merit, of the Italian Order of St. Maurice and Lazarus, and one of the eight Foreign Associates of the Imperial Academy of Sciences of Paris. In 1855 he was nominated an Officer of the Legion of Honour, and in 1863 he was made an Associate of the Paris Academy of Medicine. His death occurred on Sunday, August 25th, 1867; and he was buried at Highgate on Friday, the 30th.

Of the two former—Henry Black and Henry Clark—I have been unable to gather any particulars. I will therefore pass to Robert Warington.

Mr. Warington was born at Sheerness on September 7th, 1807. A considerable part of his school days were spent at Merchant Taylors' School. In 1822 he was apprenticed as house pupil to Mr. J. T. Cooper, then Lecturer on Chemistry to the Medical Schools of Aldersgate Street and Webb Street. When University College opened in 1828, Mr. Warington was chosen assistant by Dr. E. Turner, at first in conjunction with Mr. W. Gregory (afterwards Professor of Chemistry at Edinburgh), then by himself. Three years later he was recommended by Dr. Turner to Messrs. Truman, Hanbury, Buxton, and Co., who desired to have a young chemist in

their establishment. He held the post of second brewer there for eight years. During this period he communicated several papers to the 'Philosophical Magazine,' and also published a set of 'Chemical Tables' for students, &c. Eight years later, having resigned this position, he canvassed for the formation of a Chemical Society, and finally convened the meeting of chemists at the Society of Arts which resulted in the formation of the present Chemical Society. He held the office of Secretary to that Society for ten years, and read many papers before it.

On Mr. Hennell's death he was appointed Chemical Operator, in 1842, to the Society of Apothecaries, which office he held until ill health compelled him to resign in 1866. Soon after his appointment, and for many years, his professional engagements became very numerous. In the course of his duties there he was struck with the singular properties of glycerine. Being thought to be useless, it was allowed to drain away into the common sewer without further notice. Warington, however, saw this waste with regret, and, having some empty and unemployed carboys on hand, he collected the glycerine, and stored it away. He found it valuable in the mounting of objects for the microscopes, and mentioned its properties to his medical friends, amongst others to Erasmus Wilson, F.R.S., and Mr. Startin.

Erasmus Wilson says—"It was not long before we were startled by the complaint of one of our patients of the extravagant price of the substance. We had recommended it as inexpensive, and we soon discovered that Warington's hoard was exhausted, and that the enhanced price resulted from want of supply. Then a supply was obtained from the soap-boilers, but was so inferior to the first, and so offensive in odour, that glycerine for awhile lost its popularity. Its reputation, however, was eventually restored by passing into the hands of Price's Candle Company, by whom the best glycerine in the market is at present manufactured. In the hands of Warington, and with a prevision of its future utility, glycerine was a waste product of no value whatever by the side of the materials from which it was obtained. Soon, however, the product rose to occupy the first place, and the materials were sacrificed in its production; and for this we have to thank the foresight, the providence of Warington; for the increased consumption of the article was the best proof of its usefulness to man, and glycerine occupies at present an important place in the 'British Pharmacopœia.' The reputation of Warington and glycerine will for all time be inseparable; and we know of no more glorious monument

than the association of man's name with an object of acknowledged utility to man.

He was especially connected with questions of water-supply and gas (from 1854 to 1861 he was chemical referee to four of the metropolitan gas companies), and also took a prominent part in most of the great patent cases, &c., involving chemical questions. His scientific activity and earnestness were unabated; and when, in 1846, the Cavendish Society was founded, Mr. Warington became Secretary for the first three years. In 1849 he commenced experiments on the relations of animal and vegetable life, which resulted in the establishment of aquaria, both for fresh and sea water. He first communicated his results to the Chemical Society in 1850. Subsequently, many natural history observations made by him were published in 'Annals of Natural History,' and he delivered a valuable lecture on the Aquarium at one of the Friday evening meetings of the Royal Institution in 1857. He was an active member of the Microscopical Society, and invented a portable microscope for the aquarium.

He was appointed one of the jurors of the Chemical Section of the International Exhibition, 1862; also selected for the Paris Exhibition in 1867, but was then unable to attend. In 1864 he was elected a Fellow of the Royal Society. Mr. Warington was Consulting Chemist to the London and Edinburgh Pharmacopœia Committees engaged in the preparation of the first 'British Pharmacopœia,' 1864. He had previously assisted the College of Physicians with the 'Pharmacopœia Londinensis' of 1850; and edited, with Mr. Denham Smith, Phillips's translation of the same, on the death of the author. He was joint editor, with Dr. Redwood, of the 'British Pharmacopœia,' 1867; and assisted Dr. Farre in preparing a condensed edition of Pereira's 'Materia Medica.' Few men have passed a life of more continuous and honorable usefulness.

He died at Budleigh Salterton, Devon, on Nov. 12th, 1867, universally respected and widely lamented.

The most important of his papers were on the following subjects:

1. *Chemical.*—Sulphuret of Bismuth (1831); Chemical Symbols (1832); Chromic Acid, several (1837-41-42); Coloured Films produced by Electro-Chemical Influence and by Heat (1840); Molecular Changes in Solid Bodies (1842-43); Biniodide of Mercury (1842); Turnbull's Blue (1848); Animal Charcoal (1845); The Teas of Commerce (1844-52-53); Production of Boracic Acid and Ammonia by Volcanic Action (1855); Refining Gold (1861); besides many minor notes and memoranda.

2. *Pharmaceutical.*—Distilled Waters of the Pharmacopœia (1845); Alcohol as a Test for the Purity of Croton Oil (1855); Spirit of Nitrous Ether and Nitrite of Soda (1865).

3. *Microscopical.*—New Media for Mounting Crystals and Organic Substances (1844-48); Portable Microscope (1856-58-59).

4. *Natural History.*—The Balance between Animal and Vegetable Life in Fresh and Sea Water (1850-53); Natural History of Water-Snails and Fish (1852); Habits of Common Prawn (1855); Habits of Stickleback (1855); besides various other lesser memoranda.

I would now direct your attention to the state of our Library, and this will be best done by quoting the report of the Library Committee, as follows:

"That upon examining the books of the Society, with a view to their guidance in making purchases, in conformity with the orders of the Council, they found that the number of distinct works, exclusive of tracts and short papers, was about 240. A large portion of these works, though valuable for tracing the history of microscopical science, would be of little use in answering the inquiries of practical workers at the present day. Another considerable portion of the Library consists of works which would be rarely required, either for study or reference, on account of their relating to objects not often seen by English observers, or to subjects which seldom engage their attention. Deducting these two portions from the general mass, and also deducting a few works of inferior merit, there remained only a few dozen volumes adapted to the ordinary requirements of students and observers. There was a great want of text-books on subjects of Natural History, Botany, Anatomy, Physiology, Geology, Mineralogy, Chemistry, and Physics. There was also an absence of Dictionaries, so that, with the exception of an occasional Glossary attached to a particular work, the Library could afford no assistance in ascertaining the meaning or derivation of technical terms.

"With a few exceptions, the purchases made by the Library Committee may be described as text-books of recent date, by acknowledged authorities, on various branches of the subjects enumerated above. In the selection of works—other things being equal—the Committee gave preference to such as were supplied with reliable illustrations, and in a few instances, where they have procured more than one work

on the same subject, a diversity of illustrations has been one of the reasons by which they have been guided. The forced sale of works published by M. Baillière, consequent upon the decease of that gentleman, enabled many purchases of volumes abounding in microscopical illustrations to be made at unusually low prices; and the Committee have availed themselves of other opportunities of obtaining publications on the most economical terms. Your Committee have felt it their duty to avoid the purchase of any works of unusual costliness, although there are many publications of this class which it would be very desirable to place in the Society's Library whenever it may be prudent to make such an application of the necessary funds. The orders given by the Committee are nearly completed. Up to the present they have purchased of Mr. Wheldon to the extent of rather more than £60; of Messrs. Nock, to the extent of £10 8s.; and of Mr. Quaritch, £2 5s.

"A notice of the opening of the Library has been sent by post to each Fellow, accompanied by a request for donations of books, or of money for their purchase. The minutes of the proceedings of the Society will show that some valuable additions to the Library have been recently obtained through the liberality of various donors. Your Committee believe that so excellent an example will be extensively followed, as the wants of the Society become known.

"The Library Committee hope that the financial arrangements of the Society will permit the continued expenditure, from time to time, of moderate sums in the purchase of most important works relating to microscopical science, or of older works of established reputation, whenever they can be advantageously obtained.

"While the Library remains so small that the number of works likely to be in request amounts to only a small fraction of the number of Fellows of the Society, the Committee do not see their way to recommend a resumption of the plan of lending books; but they hope that, by donation and purchase, the Society may, ere long, be in possession of sufficient duplicates to permit an issue of works without destroying what they believe will constitute its chief value, namely, its offering at all times, to Fellows who think proper to visit it, the means of reference and research."

Yet some arrangements, I think, must be made to meet the special wants of hard-working Fellows residing at a distance from London. I am not prepared to say yet what those arrangements should be. Perhaps the best plan at present is to leave the application for books from any Fellow

to the consideration of the Council, who would comply with such request as far as possible.

From the Library let me direct your attention to our collection of Microscopic Slides. The whole collection last year amounted to 1414. I have always felt that the development of this part of our property should be one of our primary objects, and that by exchange of duplicates, by purchase, and by donations, the last mentioned particularly, we should have a museum of objects worthy the dignity of the Society.

Perhaps there is no source of instruction more important to a young inquirer than the opportunity of making himself acquainted with properly-named specimens, and I think this Society should aid, in all possible ways, the young observer. It is a real pleasure to have to report that in the past year the number of microscopic slides have been nearly doubled.

The first present I have to announce is that of Professor Smith, of Kenyon College, U.S., who generously gave us 146 slides of Diatomaceæ; and 83 other slides have been presented by W. Ladd, Professor Owen, T. Ross, Dr. Carpenter, T. Ralfs, and Mr. Lobb.

The next present is one of very high importance, being the presentation of 1031 slides, a first instalment of the collection of microscopical slides by Dr. Wallich.

The circumstances under which this present has been made, I think, should be stated. The first announcement of Dr. Wallich's intention was in a letter dated October 23rd, 1867, addressed to W. H. Ince, Esq., in which he says:

"I have a very large collection of microscopical slides and material, partly worked out by me already, and published, but to a large extent still requiring further examination. Such examination, if undertaken by anyone, would, however, be greatly facilitated from the circumstance of nearly every remarkable specimen I have come across having been carefully figured by me, and commented on in a series of rough notes, written whilst sitting over the microscope.

"I have no numerical list of my slides or drawings, but know that both amount to several *thousands*.

"I wish to present the whole to the Microscopical Society, feeling sure that the Council for the time being will form the best medium for determining the mode in which my material can be utilised.

"There are one or two preliminary conditions which I should like to see observed, should the Society think fit to accept my gift. But these I would only impose in consultation with and under the willing sanction of one or two friends on whose scientific judgment I could rely, and in whose hands I should feel I was placing myself with perfect safety.

"I would name Mr. Glaisher and yourself and Dr. Carpenter as my advisers in the matter. Of course I cannot say whether you and they would undertake a task of the kind. Should it be so under-

taken, however, I would pledge myself to accept the suggestions of this committee, and to allow my materials to be utilised, subject only to such conditions as it might think right to impose.

"This is what I want. What *I do not want* is, that my material should be employed merely for dilettante work.

"Knowing the keen interest you take in the Society, I do not hesitate to make these proposals to you, and to ask you to communicate with Mr. Glaisher on the subject."

On receipt of this letter I carefully thought over the suggested conditions, and I kept the letter for some time, but experienced very great difficulties indeed in drawing up any conditions which would not restrict the Council, for all time to come, in such a way as would lessen the Council's power to utilise the gift, and thus far lessen its value.

It seemed to me that so much material, needing a good deal of work to prepare the results for publication, might be undertaken by some of our hard-working Fellows in the country, and therefore the conditions should be such as to leave the Council free to let them, for a time, be in the hands of country members, if necessary.

On November 26th I had a long and final interview with Mr. Ince upon this matter, who undertook to communicate to Dr. Wallich my views and the results of our conference, which he did on November 27th. On November 28th, Dr. Wallich wrote to Mr. Ince as follows:

"Lest any misgiving may exist or arise on the subject, I think it as well to put thus on record, in order that you may make whatever use you like of the information, that I submit the offer of my collections, drawings, &c., to the Society, hampered by *no condition or reservation whatever*. The few words in which you conveyed to me last evening your opinion that means would be taken to prevent slides, &c., from being lost, having at once met the sole purpose I had in my mind when I previously wrote to you on the subject.

"When I add that I feel sure the Society will, through its present executive (supposing my offer to be deemed fit for acceptance), do whatever is best in the matter, I have said all I have to say."

Thus, generously and unconditionally, Dr. Wallich presented the "Wallich Collection" to this Society.

It then appeared to Mr. Ince and myself, that if Dr. Wallich could go over the slides, and make brief notes on anything necessary, that great additional value would be given.

On December 5th, Dr. Wallich, in a letter to Mr. Ince, says:

"I have commenced going over the slides in my cabinet, and see so much that I should like to make a brief note of, for submission to the Society, with the specimens themselves, that I cannot help thinking it would be highly desirable to defer making over the collection

till the *January* meeting. A few words indicating the object especially pointed at, the questions they are calculated to throw light upon, and so forth, could soon be put into shape by me; but it would be impossible for me to devote more than a very brief period daily to the task, and to do it at all by Saturday next is impossible. I should also like to offer a few remarks (the last, in all probability, I shall ever make on subjects of the kind) on the drawings. These would greatly help any observers who might wish to work out the history of structures referred to, and, both in the case of the slides and figures, would save others a vast deal of trouble. Now I know each slide and drawing as if they were old, well-known friends, and *to me* the labour would be but trifling. It is the *time* I want, and there is no way of gaining this except by the delay I speak of.

"But pray accept this only as a suggestion, meant to do good in the end. If you would rather your original idea of presenting the things to the Society at the next meeting were carried out, I shall be quite willing and happy to be guided by you. Under any circumstances I hold myself *pledged* to do as you and Mr. Glaisher wish in the matter."

After this, at an interview with Mr. Ince and Dr. Wallich, I having expressed my desire that, as the slides and drawings had relation to subjects of natural history carefully collected and as carefully studied by him in different parts of the world, I should be glad if he would classify and explain the collection of the slides and drawings, and, if possible, have such a description ready for my address to-day. I regret to say that, since then, Dr. Wallich has been continuously ill, and unable to do so; but I do hope still that he will enrich our Procedings by such a description, which I feel would greatly enhance the interest and value, and perhaps act as a guide to their usefulness in the future.

By the report of the Cabinet Committee, it will be seen that they are engaged in rearranging, reclassifying, and they contemplate relabelling every slide. This will necessitate the printing of a new Catalogue.

I would now call your attention to the state of our Instruments. Upon examining them, preparatory to placing them in our new Library, many pieces of apparatus were found wanting. For instance, from the old microscope, by A. Ross, there were wanting—frog plate, two large animalculæ cases, case of animalculæ tubes, $\frac{1}{6}$ object-glass, cabinet micrometer, 1-inch Lieberkühn, single lens cover, case of single lenses.

Since then, Andrew Ross' instrument has been put into thorough working order, and the objectives have been adapted to the Society's screw.

Mr. Thomas Ross has presented us with a new 4-inch objective.

Mr. Wray has presented us with a $\frac{3}{5}$rd-inch objective, having 50° of angle of aperture.

Mr. Browning has supplied us with a very beautifully made micro-spectroscope, and fitted it to our large Ross.

We therefore possess, omitting the ancient instruments, Mr. Peters' instrument for microscopic writing and eight microscopes, including a most complete binocular by T. Ross; a good Andrew Ross, wanting the $\frac{1}{8}$th objective, which seems to be lost; an old Smith and Beck; a good working instrument by Powell, lately converted into a binocular; a binocular by Baker; two binoculars by Swift, purchased this year.

All these instruments are most useful and serviceable; and I have reason to believe that good use has been made of them on the Wednesday evening meetings of the Fellows, and in the Library.

Our various instruments also mark the progressive stage of improvement in the microscope; beginning with Martin and Culpepper, to the best of modern makers.

We therefore possess, at present, as complete a set of instruments and working tools as it is possible to obtain; and I hope, as they will be more used and more constantly under observation, that we shall not experience more losses; and I also hope the Council will always be able to purchase all the latest improvements of the best makers of the respective instruments.

You are already aware that the authorities of King's College kindly entertained the application of the Council for a room in the College, and that now we possess, for the first time, accommodation for the proper use of our instruments, admitting frequent access to them by our Fellows. We have had to fit the room up, to furnish it with bookcases, &c.

When we came into possession of this room, it was necessary to examine carefully all our property. This examination proved that some books were missing, some slides broken, and some parts of instruments wanting. These experiences have taught us that all the property of the Society should be carefully catalogued, and, I think, has also taught us the necessity that once, at least, in every year every book, slide, and parts of instruments, should be compared with their catalogues.

On the collecting the property of the Society at our room, and seeing its value, your Council resolved to insure the property, and have done so, the amount of insurance being for £800, a sum, I believe, below its real value.

I have thus endeavoured to speak of the work of your Council during the past year; and I would ask those Fellows who have expressed disappointment at the temporary suspension in lending books, to consider the circumstances

in which the Council, as trustees of property, found themselves placed, and how necessary it was to examine everything we have, to ascertain our deficiencies, and, as far as possible, to supply them, in order to make our Library, our Cabinet, and our Instruments, as perfect as possible.

The papers which have been brought before the Society during the past year have presented many features of considerable interest, and relate to various branches of microscopical science.

Two of these papers have related to parasites—one by Dr. W. C. McIntosh, F.L.S., on the "Gregariniform Parasite of Borlasia" (March 13), and another on the "Parasites found in the Nerves, &c., of the common Haddock," by Dr. Maddox (June 12).

Dr. McIntosh found abundant specimens of Gregarinæ in the Nemertian worms, known as *Borlasia octoculata* and *Borlasia olivacea*. He likewise discovered numerous ova containing embryos that appeared to be Gregarine parasites, though he did not witness an actual birth. It was remarked that these parasitic ova were most plentiful in August, while the Borlasia deposited its ova towards the end of January.

Dr. Maddox's paper gives an elaborate account of curious parasites discovered and partially described by Monro secundus, more fully investigated by Prof. Sharpey in 1836, and Mr. H. Goodsir in 1844. Dr. Maddox states that on making an incision along the caudal extremity over the spinal column of the common haddock, and dissecting back the muscles, the series of nerves, as they pass from the spinal cord, are found studded with flattened bead-shaped bodies, plainly visible to the naked eye.

Observed under the microscope, these bodies are found to be cysts, averaging about $\frac{3}{100}$ths of an inch in diameter, and containing a living parasite similar to Distoma. Many of the anatomical details described by Dr. Maddox do not appear to have been noticed by previous observers; and for these I must refer to the paper itself, citing only one passage on which certain important conclusions are expressed.

Dr. Maddox says, "According to the opinion of many, the encysted entozoa are regarded as immature parasites or in their pupa condition, and doubtless this may be the case; but how far the peculiar creature under consideration has deviated or passed to a higher grade and become partially sexually mature, I cannot say, but venture to hazard the following suggestion:

"That we have here, as in other Diatomata, a herma-

phrodite creature, which in its progress towards a reciprocal sexual maturity yet carries on self-impregnation, so that, at the death of its host, and thus within a moderate time of its own death, impregnated ova may be set free to again become, perhaps, Monostoma embryos to pass through a Cercarial stage, or the lowest phase of a Trematode life" (Q. J. M. S., Oct., 1867, p. 94). Dr. Maddox thinks it possible that the earliest stage of the parasites may be passed in the bodies of shell-fish, which the haddock eats.

In March, Mr. Whitney brought before us a series of remarkably interesting researches in a paper "On the Changes which accompany the Metamorphosis of the Tadpole, in reference especially to the Respiratory and Sanguiniferous Systems;" and those who had the pleasure of hearing this paper read will remember the beautiful series of coloured drawings and anatomical proportions with which it was illustrated.

Mr. Whitney explained the nature of the two sets of gills, one external and the other internal, with which the tadpole is furnished. He showed the way in which the respiratory function is transferred from the outer to the inner gills; the *development* of the latter taking place in proportion to the *atrophy* experienced by the former.

After showing, stage by stage and step by step, the development and the changes which take place in these two sets of gills, Mr. Whitney described the true lungs which co-exist with the gills of the tadpole in an incipient form, and pass through their gradations of development simultaneously with those phases of maturity, decline, and decay exhibited by the gill organs. To see the action of the inner gills in a living tadpole, Mr. Whitney applies a single drop of chloroform to render the creature insensible, and then carefully cuts away the integument with fine scissors, thus laying the gills bare, while the circulation is vigorous, and capable of affording a splendid spectacle on the stage of the microscope.

In May we were indebted to Dr. Lionel Beale for a paper on "Nutrition exhibiting many facts of the highest importance, arrived at by Microscopic Investigation, and controverting opinions expressed by Mr. Herbert Spencer and other well-known writers on Biological Subjects concerning so-called 'Vital Action Processes.'" Dr. Beale, as my hearers are well aware, divides the matter contained in living bodies into three classes—germinal matter, formed material, and pabulum. The first only he considers alive, or possessed of vital properties. The *formed material* he regards as no

longer living, and the pabulum consists of appropriate matter derived from food, and capable of being acted upon by the germinal matter and converted into its own substance.

He says, in the paper to which I am referring, "calling the germinal matter which was derived from pre-existing germinal matter *a*, the pabulum *b*, and the formed material resulting from changes in the germinal matter *c*, that *b* becomes *a*, and *a* becomes converted into *c*, but *b* can never be converted into *c*, except by the agency, and, in fact, by passing through the condition, of *a*."

Dr. Beale considers that, in the present state of our knowledge it is impossible to explain the conversion of pabulum into germinal matter by physics or chemistry, but he believes that "vitality excites germinal matter to divide itself into smaller portions under the influence of some 'centripetal force.'" "This moving away of particles from a centre will necessarily create a tendency of particles around to move towards the centre," and then the nutrient pabulum may be drawn in.

It is not my purpose to discuss the very important questions upon which Dr. Beale is at issue with certain other distinguished authorities; but the value of that discussion will be apparent if I bring before you another passage from his paper, and contrast it with a citation from M. Berthelot, in whose hands Synthetic Chemistry has made such remarkable progress.

Dr. Beale says, "The point in which every nutritive operation differs essentially from every other known change is this: the composition and properties of the nutrient matter are completely altered, its elements are entirely rearranged, so that compounds which may be detected in the nutrient matter are no longer present when this has been taken up by the matter to be nourished. The only matter capable of effecting such changes as these is living matter. * * * * Desirous as I am to yield all that can be yielded to those who maintain that there are no vital powers distinct from ordinary force, I might say that a particle of soft transparent matter, called by some living, which came from a pre-existing particle, effected, silently, and in a moment, without apparatus, with little loss of material, at a temperature of 60° or lower, changes in matter, some of which can be imitated in the laboratory in the course of days or weeks by the aid of a highly skilled chemist, furnished with complex apparatus and the means of producing a very high temperature and intense chemical action, with an enormous waste of material. It is, therefore, quite obvious that an independent, scientific

man must, for the present, hold that the operations by which changes are effected in substances by living matter are in their nature essentially different from those which man is about to employ to bring about changes of a similar kind out of the body; and until we are taught what the agent or operator in the living matter really is, it is better to call it vital power than to deny its existence altogether."

I am not aware of a better expression of the other side of the controversy than a passage from M. Berthelot.* M. Berthelot observes that "the general problems of the nutrition of living beings are chemical problems, and so are those of respiration. The study of these problems rests upon data supplied by organic chemistry. In animal tissues, as soon as the solids, the liquids, and the gases are brought into reciprocal contact, under the influence of movements which are referable to the nervous system and to a special structure, which we do not know how to imitate, purely chemical affinities develop themselves amongst these solids, gases, and liquids, and the combinations to which they give rise depend exclusively on the laws of organic chemistry."

In another place M. Berthelot affirms that "synthesis conducts us to this fundamental truth, that the chemical forces which rule over organic matter are really, and without reserve, the same as those which rule over mineral matter."

It is evident that while chemistry may do much to solve questions of this description, the microscope is an essential instrument in their investigations, for without it the student would be utterly unable to understand the character of the apparatus which nature employs in living beings, and the chemist himself would be in constant danger of treating as homogeneous wholes portions of matter which the microscopist can demonstrate to consist of separate and dissimilar materials.

I will only further allude to Dr. Beale's paper for the sake of observing that it contains important reasons for regarding the materials contained in the *serum* of the blood as the pabulum of the tissues.

At the same meeting at which the paper on Nutrition was read, Dr. Beale made a brief communication to meet an objection made by Dr. Ransom to his plan of staining tissues with carmine, on the alleged ground that the ammonia present in the solution rapidly dissolved the germinal vesicle and contents of the Ovarian ova of a stickleback.

Dr. Beale explains that there must have been some

* 'Leçons sur les Méthodes Générales de Synthese en Chemie Organique.' By M. Berthelot. p. 9.

mistake in Dr. Ransom's method of procedure, as ammonia does not exert the action he supposed.

In May, Mr. E. Ray Lankester contributed a paper on "The Structure of the Tooth of Ziphius Sowerbiensis," and in November Mr. Edwin T. Newton brought before us certain "Anatomical Differences observed in some Species of the Helices and the Limaces," the difference being "in the reproductive organs, where some of the parts become modified or suppressed; in certain additions to the alimentary canal; and in the variations which the muscles undergo.

In December, Mr. C. Stewart brought under our notice the "Structure of the Pedicellariæ of the Cidaridæ," and on January 7th Prof. T. Rupert Jones, F.G.S., gave us an account of "Fossil Bivalved Entomostraca," showing their extensive range of distribution in geologic times.

In this last paper allusion was first made to the great abundance of Entomostraca recognisable in the fossil state in clays, marble, freestones, chalk, &c., as having left their shells and cases in the sediments of seas, lakes, and rivers of all geologic dates, just as at the present day we find the living species swimming in the water, crawling on the sands, or burrowing in the mud.

Prof. Rupert Jones explained the general nature, structure, and habits of the Entomostraca, and of the bivalved forms in particular, pointing out their relations to other Crustaceans. He also gave an account of their distribution in various rocks, from the Silurian to the Post-pleiocene, for the details of which I must refer to his paper.

Only one paper during the session referred to Entomology, which was read in June by Professor Rymer Jones, F.R.S. The subject was "The Structure and Metamorphosis of the Larva of *Corethra Plumicornis*," one of the most elegant inhabitants of fresh water ponds. The anatomical details in this paper will be found of much interest, and the description it gives of the bursting of the four remarkable air sacs with which this creature is provided, followed by the rapid appearance of a tracheal system, suggests very interesting inquiries, which it is hoped Fellows of this Society will undertake. It cannot be supposed that an elaborate tracheal system is made of a sudden; and it does not appear that either Professor Rymer Jones or any other observer has hitherto succeeded in tracing the usual process of development.

In November Mr. John Gorham read the only truly botanical paper of the session, on a "Peculiar Distribution of the Veins in Leaves of the Umbelliferæ." Mr. Gorham

observes that "the distribution of the veins in Umbelliferæ is very variable in different species, but constant and highly characteristic in each species:" "that many of the leaves of this order have a venation like that of other leaves, and may be classified with them; but that a considerable number have a kind of venation peculiar to themselves, which does not find a place under any of the divisions that have heretofore existed:" "that this peculiarity consists in the existence of a vein at the very edge of the leaf itself, and which more or less entirely fringes the whole margin." This venation he finds in one half if not more of the Umbelliferæ.

In December Mr. Tatem described new species of microscopic animals belonging to the genera Epistylis and Cænomorpha.

Two other papers of the session relate to microscopic organisms: the first by Mr. Sheppard, communicated by the Rev. J. B. Reade, who previously had investigated the subject. This paper, "On the Production of Colour by Microscopic Organisms," brought a subject before us interesting in itself and new to English observers. Dr. Cohn of Breslau had, however, made similar researches, which are recorded in our 'Journal' for last July, and in a letter to Mr. Sheppard, dated Breslau, Nov. 1, 1867, which I read at a recent Council meeting, Dr. Cohn says, "Curiously enough in the last summer a third memoir about 'Phycocyan' (his own name for the colouring material) has appeared in the 'Botanische Zeitung von Mohl und De Bary,' from Dr. Aschkenasi, each observation quite independently made from the others."

We may therefore hope that the question, "Whence the colour?" will be soon and fully answered. Mr. Sheppard is of opinion that the intense colour produced in a few hours by a few grains of almost colourless organisms, in more than two ounces of albuminous fluid, is due to the action of life on this suitable vehicle; and he supports his opinion by a reference to M. Pasteur's statement on the similar action of certain monads and vibrios on nitrogenous substances.

Dr. Cohn, on the other hand, is of opinion that his Phycocyan already exists along with Chlorophyll in the cells of these low organisms, and "on the *death of the cells* the phycocyan is dissolved in the water, which penetrates by endosmosis, and then appears by dialysis as a blue fluid, whilst the chlorophyll remains in the cells." ('Journal,' p. 209.)

But Dr. Cohn, in thanking Mr. Sheppard "for his highly interesting communication," admits the necessity of further experiments, "that the truth may be established;" and after

intimating his intention to pursue the subject further, he concludes, "I shall also endeavour to repeat your experiments with albumen, the influence of which upon the colour seems very curious after your investigations."

The Rev. J. B. Reade exhibited a "thousand grain" bottle of the dichroic fluid at the Society's Soirée, and Messrs. Sorby and Browning have described its remarkable spectra. In a letter from Rev. J. B. Reade, dated Feb. 3, 1868, he informs me that the convervoid mass, which produced that splendid colour in a solution of albumen, is growing again, and that Mr. Sheppard will soon gather it again in velvety sheets, in sufficient quantity for different observers to work upon, and no doubt we shall soon know the truth.

The second paper referring to minute organisms was by our Hon. Secretary, Mr. Slack (read in December), "On a Ferment found in French Wine," corresponding in properties with M. Pasteur's *Mycoderma vini*, and shown to be one of the series of forms assumed by the Yeast plant, the Blue Mould *Penicillum glaucum*, &c. It was incapable in its original state of exciting either vinous or acetous fermentation.

The subject of Micro-chemistry and Toxicology came before the Society in a paper read in October by Dr. Guy, "On Microscopic Sublimates." This paper was richly illustrated by specimens of the objects described by photo-micrographs of Dr. Julius Pollock and Dr. Maddox, and by drawings of Mr. Tuffen West. By carrying further than previous observers had done the preparation and examination of microscopic sublimates, Dr. Guy has opened new and important fields of inquiry and analysis, which bid fair to be useful in medico-legal and other investigations. His preparations were remarkable for the elegance and variety of their forms, and for the very small quantities of matter which sufficed to produce them. In one instance $\frac{1}{1000}$th of a grain of crystallized strychnine yielded nine distinct sublimates in succession, and among them there must have been one weighing less than the $\frac{1}{10000}$th of a grain.

Notwithstanding the difficulties arising from the existence of isomorphic bodies and the changes in crystalline forms, resulting from peculiar conditions, and the presence of substances interfering with normal results, there is reason to hope that processes of this description may in many cases yield definitely characteristic indications, and in others afford evidence which may be of great importance as portions of a chain of proof; and Dr. Guy's researches will be regarded as all the more valuable from the difficulties that frequently attend ordinary methods of investigation.

Passing from organized beings to apparatus, I find a valuable paper, contributed by Dr. Carpenter in June, on "Nachet's Stereo-Pseudoscopic Binocular Microscope."

From the construction of this instrument the observer is able to pass immediately from a *stereoscopic* to a *pseudoscopic* view of any object under investigation. It is only necessary to change the position of the prism figured in the illustrations to this paper, in order to send the rays to the left eye which belong to the right eye, and *vice versa;* the effect being that all stereoscopic results are *reversed.*

Dr. Carpenter also referred to the application of Nachet's binocular magnifier to Beck's dissecting microscope, with which he found its performance of great value.

Microscopic lamps have been brought several times before us during the year. Mr. Lobb described and exhibited an elegant little camphine lamp made by Young. Mr. Piper exhibited a convenient and economical travelling lamp. Messrs. Murray and Heath exhibited an ingenious telescope lamp, made with sliding tubes, by which its height can be varied; and Mr. Bockett exhibited a lamp (made by Mr. Collins) furnished with a form of parabolic illuminator and chimney screen, adapted to prevent the diffusion of light, and to concentrate it in parallel rays proceeding in the direction required.

Amongst the presents which have lately enriched the Society's collection is a new four-inch objective contributed by Mr. Ross. Low powers have been too much neglected by modern microscopists. Messrs. Powell and Lealand indeed have been in the habit of making a dividing objective of which the lowest power was four inches; but its utility does not seem to have been sufficiently perceived. Mr. Ross's four-inch gives great satisfaction to those who have tried it. It enables a satisfactory view to be obtained of many living objects, such as polyzoa and compound polyps, too large for higher powers. It also gives excellent results with many anatomical preparations, entire insects, and large polariscopic objects. When employed with the deeper eye-piece and the binocular microscope, it enables considerable magnification to be obtained, accompanied by a depth of penetration which higher objectives with larger angles of aperture cannot give.

Mr. Wray has presented to the Society a two-thirds objective with an angle of aperture of 50°. This glass is stated by those who have examined it to possess a high degree of merit; but excessive angles of aperture are necessarily fatal to penetration, and involve peculiar optical errors from a confusion of perspectives. We very justly praise them as

specimens of an optician's skill in overcoming difficulties, and they may be valuable for *particular* investigations; but they can never take the place of objectives in which the angles of aperture are so proportioned to focal length as to make the microscopic vision of inanimate objects resemble as closely as possible the natural vision of larger ones. Important observations on this subject have been made by Mr. Wenham; and Dr. Carpenter's paper on Nachet's binocular contains some valuable information, reinforcing opinions he has long expressed.

It must not be supposed in these remarks that I am in any way underrating Mr. Wray's labours. It is certainly desirable that microscopists should be able to form their own conclusions by experiments on this subject, and a well-made two-thirds, such as Mr. Wray has presented to us, with what may be described as an *enormous* aperture may be advantageously compared with objectives of similar power made by Mr. Wray or other makers, in which the angle of aperture is much less.

During the past year few important novelties in microscopical apparatus appear to have been introduced. Mr. Highley has brought out a very elegant miniature microscope for the pocket. It is contained in a round German silver case, four inches long and three quarters of an inch in diameter, and can thus be easily carried in the pocket. It is furnished with a tin box and a dividing objective, and a draw tube. Its power is sufficient to enable the collector to recognise the nature of his gatherings, when they consist of Diatoms, Desmids, and other microscopic Algæ; and in many cases it would afford the medical man the means of distinguishing marked products. Though not new in principle, the smallness and convenience of this little instrument entitles it to mention.

Messrs. Murray and Heath also exhibited a new form of pocket microscope, which can either be used as a hand microscope or secured by a single thumb-screw to a very firm folding tripod stand. It is capable of being placed at any desired inclination, and firmly fixed in any position by the same screw which fastens it to the stand, and which acts as an axle clamp. The whole packs in a case measuring only $6\frac{1}{2}$ in. × $3\frac{1}{2}$ in. × $2\frac{1}{2}$ in. deep.

Mr. Ross has devised a new object-holder, which will prove of much use in many special inquiries.

Microscopists frequently desire to examine unmounted objects of various dimensions, which cannot be held in the stage forceps, partly on account of their limited opening,

and partly from the want of parallelism in the approach of their two blades. In the new instrument a screw motion adjusts the distance between two parallel blades, so that they will grasp any object from three quarters of an inch in diameter to the smallest size which forceps of any kind can advantageously hold. Natural and artificial crystals to be viewed with the polariscope or the micro-spectroscope, or under the Lieberkühn, may be mentioned as amongst the objects for which this holder is especially useful. It has universal motions, and may be used like the stage-forceps, or attached to a separate brass frame, which is most convenient.

I may also call attention to an apparatus contrived by Dr. Stricker, for the examination of objects exposed to various gases, or to an electric current, which is described in the 'Quart. Journ. Mic. Sci.,' p. 40.

Mr. Curteis (of Baker's) has introduced a convenient series of slide-cells, of different forms and sizes, which are very handy in viewing living objects. They are hollowed out of glass slides, and furnished with thin glass covers attached to revolving brass buttons. They are made in sizes adapted to objects like Conochilus or to elongated aquatic larvæ.

The International Exhibition at Paris last year afforded another opportunity of comparing microscopes made by makers in different countries. As a juror at the Exhibitions in the years 1851 and 1862, and as reporter at the former, I had good opportunities in the examination of all the microscopes exhibited, and doubtless, at both these times, the English opticians held the first place.

It has been reported that this was not the case at the recent Exhibition, and I have been anxious to ascertain the facts, as, since 1862, our makers have steadily continued to improve both stands and object-glasses. I learn that there was only one meeting of the jury for microscopic examination, and that was in a small room with many lamps. I scarcely need say that careful and minute comparison under such circumstances was impossible.

That the best continental makers have considerably improved upon their previous efforts is generally admitted; but in no case do they appear to have reached the very high degree of excellence attained by the best English artists. It is rather in America than on the Continent that our opticians have to fear rivalry; and some objectives, constructed by Mr. Wales (an Englishman settled in that country), have been deservedly spoken of in terms of the highest praise.

Dr. Maddox has recently brought before our notice a

series of American photomicrographs of the Podura scale, in which the best results were obtained with Powell and Lealand's $\frac{1}{50}$th, then with Wales' $\frac{1}{8}$th and amplifier, and Wales' $\frac{1}{25}$th immersion lens. Hartnack's No. 11 immersion lens did not give a good result, which Dr. Woodward thinks might have resulted from the great want of coincidence of the visual and chemical rays, but which Dr. Maddox is disposed to ascribe to some trifling error in centering when the necessary chemical correction was made.

In the course of a recent discussion concerning the comparative merits of English and continental objectives, there has been a disposition, in some continental quarters, to condemn the use of deep eye-pieces, and this fact points to the imperfection of the continental objectives. An English microscopist invariably tests his objectives with deep eye-pieces, and condemns those which will not stand the trial.

A first-rate glass will perform much better with a B or C eye-piece than a second-rate one with an A eye-piece; and it is often extremely convenient to use a lower power with a deeper eye-piece in preference to a higher power with a lower eye-piece, as the former method gives a greater working distance between the lens and the object, and a greater degree of penetration—that is, presuming the lower objective has a smaller angle of aperture than the higher one.

No continental maker exhibited any microscope stands possessing the finish or the mechanical advantages of our first-class instruments; but a cheap form, devised by Nachet, was found to be meritorious and convenient, having an excellent rotating stage, a point which Dr. Carpenter—than whom there can be no better authority—considers essential to the best working of a binocular instrument, as, without it, it is often impossible to bring an object into the most advantageous position with regard to the light.

There is, however, one point to which I wish to direct attention, and that is, the excellence of some of the French objectives corrected for immersion; that is, introducing a drop of water between the covering-glass of the object and the outer surface of the objective.

This plan, as Dr. Maddox reports to us, has been successfully adopted by Mr. Wales in America. It was originally introduced by Amici, and some rather rough experiments were tried by Mr. Andrew Ross and by Messrs. Smith and Beck, who came to the conclusion that it was not the best mode of obtaining the desired result; it may, however, be advisable to reconsider this decision.

Where the largest possible angles of aperture are required

for the most difficult lined objects, the immersion system may be found the best and most convenient, though glasses specially corrected for examining such objects in an uncovered state, might give a more reliable result.

The late Richard Beck strongly advocated this mode of observing Diatoms, and had a great number of them mounted, so as to be viewed without covering-glass. Mr. Ross has also experimented in the same direction. In such observations broken valves of Diatoms are the most instructive in showing the real character of the marking, and the most ready way of obtaining such specimens is to press the moist Diatoms between two pieces of thin glass, allow them to dry, and then separate the glass discs, in which fractured portions of the valves will be found to adhere.

The extreme angles given to object-glasses for the purpose of displaying the most difficult surface markings, render them comparatively useless for ordinary and more important work; and microscopists are now agreed as to the soundness of the opinion enunciated some years ago by a former President of the Society, Dr. Carpenter, in favour of angles of aperture which are consistent with a due amount of penetration, and which do not distort the appearance of objects by the false perspectives which inordinate angles of aperture produce.

If we regard immersion lenses from this point of view, we shall perceive that their value must be very limited, when their object is simply to produce the effect of extreme-angled objectives; but they may still have an important field of utility, when applied to the highest powers, by their action in increasing the working distance between the object and the objective.

Where the immersion plan cannot render some peculiar and special service, it is open to the objections generally made by English microscopists, that the objective requires frequent wiping, and that the employment of water is dangerous to mounted objects, if any portion of the covering-glass is cracked, or there should be any marginal crevice through which the fluid can penetrate.

In my address of last year, I brought before you the very gratifying fact of the formation of the Old Change Microscopical Society; this Society, I am glad to say, has proceeded well, and is prospering under the presidency of Mr. Leaf. I have heard of the formation of similar Societies, but I have not had any communication with them; but every year adds, and I hope will increasingly add, new evidence of the appreciation in which microscopical science is held by all classes, and particularly those interested in education. I

am glad to learn that under the presidency of one of our Fellows, Mr. Hall, a Microscopic Section has been formed in connection with the Mutual Improvement Society at Hackney. The earnest uniting together for the purchase of microscopes and microscopical literature is a gratifying proof of this new Society's progress. While speaking of Societies, I think it is a matter of regret that we have no relation or connection with the many good Microscopical Societies which are in existence in nearly all our large towns, and mutual benefit, I think, would follow if some sort of connection could be formed, by which we might afford accommodation to their members when visiting the metropolis, and they, in turn, might communicate to us important information, and enrich our cabinet by the contribution of duplicate slides.

During the past year, the wide acceptance of the germinal theory of disease has given fresh vigour to the employment of the microscope as an agent in the work of the sanitary reformer. The Board of Health Privy Council have had many clever men at work with the microscope investigating the cattle plague, cholera, &c. Many of our zymotic and epidemic diseases will receive much light from the instrument our Society has done so much to place in the hands of every one, and taught how to make use of to good purpose; but in this department the instrument is only in its infancy.

I will now advert to a subject intimately connected with our future prosperity.

The growing importance of the Royal Microscopical Society, and the increasing demand for records of its transactions, have led your Council to take into their serious consideration the mode in which they have been published for some years past. It is not consistent with the dignity of a Royal Society that its proceedings should exclusively appear in a publication over which the President and officers of the Society have absolutely no control. The arrangements entered into with the editors of the 'Quarterly Journal of Microscopical Science' take the mode and form of publication, the quantity of illustrations, and other important particulars entirely out of the hands of the Society's officers, which precludes the Society from obtaining, except at a very heavy expense, the number of copies required for presentation and exchange. Considering these and other difficulties arising from that arrangement, your Council decided upon giving notice to terminate the agreement after the publication of the October number for the current year, which will complete the volume for 1868.

In devising new plans of publication, the Council hope to secure for the Fellows of the Society greater advantages in proportion to the sum expended, and so to meet the views of gentlemen engaged in original researches that they may be induced to send their papers preferentially to this Society, even when, as is often the case, other Societies of great influence might be open to their reception.

I think the time has arrived when the Council may take into their serious consideration the propriety of awarding a gold medal for the results of patient researches or papers of high microscopical merit, or for new inventions, &c., in the hope of encouraging our Fellows and others to work zealously and patiently.

Annually to confer a Royal Microscopical Society's medal for work of high merit would, I believe, tend to the prosperity of the Society, by causing papers of the highest class to be brought to us. This subject, together with all the details connected with the publishing of our "Transactions," will come under the consideration of your new Council, and I do not doubt that with their care and attention to this subject, important improvements may be effected.

There is another matter which, I think, deserves attention. It has been the practice of the Society to invest in the public funds all the money paid by compounding Fellows; this practice is a sound and good one in the infancy of a Society, but plainly a time must come when more money will be invested than that corresponding with living compounders, and after this the death of a compounder might with propriety release for use, if required, the amount of his composition.

By the Treasurer's account to-day we see that we have more than £1000 consols, and a sum of £168 waiting investment; that all the extra heavy expenses incurred this year have been paid, and that the balance at the bankers exceeds by a good deal our present liabilities.

That our finances are in so good a condition is due to our acting Treasurer, Mr. Ince, who has been indefatigable in the interests of the Society, and to whom our best thanks are due.

Under these circumstances, it becomes a matter for consideration with the new Council whether we shall now conform to the usages of other old and well established Societies in this respect.

I hope by these means to be able to comply with the wish expressed of the Library Committee to devote some funds annually to the purchase of necessary works; and I also hope the Council will be able to devote any sum necessary

for the purchase of slides, when such as we want may be had by purchase.

At the last year's anniversary our numerical strength was 390; in the session just closed the elections have numbered seventy-four; we have lost four by death, and eight by resignation. Our present strength is, therefore, 452 Fellows; of these 361 are annual subscribers, and ninty-one compounders.

Thus the Society is flourishing, as viewed in respect to finances, number of its Fellows, and increase in property.

The last year has been one of great and unusual exaction of time and work from all your officers, and particularly from the secretaries, without whose zealous assistance I do not know how all the work could have been done which has been done, nor the library prepared for use; I am greatly myself indebted to them.

In conclusion, I beg to offer my thanks for the courtesy I have received from every member of every committee, and from every member of the Council, and to you for the support you have given me in performing the duties of your President.

Observations *on the* Microscopic Alga *which causes the* Discoloration *of the* Sea *in* various parts *of the* World. By Dr. C. Collingwood, M.A., F.L.S.

(Read March 11th, 1868.)

Although a great deal has been written at various times on the subject of the floating substance known to sailors as sea sawdust, whale's food, &c., it does not necessarily follow that there is not still much to be added by those who have themselves observed the phenomenon. Moreover, although travellers have from time to time recorded the appearance of this substance upon the surface of the ocean in different parts of the world, it so happens that those who have written the most elaborate articles upon it have either never seen it (as, for instance, Montagne), or had but limited opportunities for its observation, which latter was indeed the case with Ehrenberg. Again, the interesting accounts written by these naturalists have referred almost exclusively to the substance produced in the Red Sea, and to which they attribute its

name, while other observant travellers have mentioned it as a singular phenomenon of somewhat rare occurrence, giving the date, and latitude, and longitude of the event. Thus Darwin, who circumnavigated the globe, and was five years at sea, cites but two occasions on which he observed it, viz., near the Abrolhos islets, and off Cape Leeuwin ; the conferva seen near the Keeling Islands having been of quite a different character.

One circumstance much dwelt on by those who have described this substance is the red colour it imparts to the sea, so much so, that whether it is De Candolle who examines the waters of the lake of Morat, or Ehrenberg at the Bay of Tor, or Montagne describing the dried specimens which had been obtained from the middle of the Red Sea, they all agree in calling it *erythræum*, or *rubescens*, while Ehrenberg improves upon this by naming De Candolle's species *Oscillatoria Pharaonis*, from a Rénanish idea that this is the natural explanation of the waters turned into blood in the plagues of Egypt. It is described by some as *blood-red*, by others orange-red, or brick-red when expanded over a large surface, and we are assured that the Red Sea or Mare erythræum of the ancients, *Bahr Souph* of the modern Arabs, is so called from this red Alga, the Arabic name simply meaning *Mare algosum*.

I do not for a moment call in question this red appearance which seems to have been so often observed in the Red Sea, but I only wish to remark that numerous as have been the occasions on which it has been my fortune to observe the sea to be discoloured by a floating Alga, in the Eastern and Western Hemispheres, I have never at any time seen it approach a red colour, much less assume the *rouge de sang* of the French writers. The only time I ever saw the sea of a blood-red colour was in a limited space in the Formosa Channel, when I satisfied myself that the red appearance was due to myriads of minute gelatinous worms which filled the water.

In passing down the Red Sea, indeed, although during a week always on the look-out, I saw no trace of red or any other discoloration. This was early in March. Ehrenberg's observations were made in December and January ; Dupont's in July ; and De Candolle's "at the end of winter." It was not till I was in the Indian Ocean, in long. 70° E. and lat. 5° N., that I first observed that the sea had, as I entered it in my journal, a *dusty* appearance, as though myriads of minute bodies were floating in it, not all upon the surface, but at various depths beneath. This appearance was rendered

very remarkable by the sun shining upon the sea, when they sparkled in the light. Not at first recognising their nature, I supposed they might be minute animals, and the source of the luminous sparks which had shown so brilliantly at night; but, upon examination, I found them to be small bodies, having the appearance, under a lens, of sheaves of fibres, constituted as though bound round the middle, but loose at the ends (see Pl. VII, fig. a), like sheaves of corn in miniature. Placing them under a microscope, they presented appearances to be presently described, but, singularly enough, having called the attention of the surgeon of the mail-steamer to them, he at once exclaimed that it was just what he had seen when he had placed under his microscope some of the substance upon the Red Sea, which he had more than once had an opportunity of observing when a red tint was prevalent.

I will first state the localities in which I have observed this substance, and its general aspect, and afterwards describe the microscopic appearances presented by it in various places. I saw no large patches or discoloration of the sea through it anywhere in the Indian Ocean, either north or south of the line, in a single passage across each, but, as I have just stated, the first traces of it appeared to me in the North Indian Ocean in March. So in the South Indian Ocean in May, lat. 28° 29′ S., and long. 38° E., I again observed the sparkling appearance in the water, and once more found it to be due to "dust," but not of the sheaf form, but in wedge-shaped bundles to be presently described.

In the Atlantic, I only once observed it, viz., in June (lat. 8° 28′ 5″ S., and long. 28° 32′ W.), when, standing on the forecastle one day, my attention was arrested by the sparkling in the water which indicated the presence of sea-dust, and presently after we crossed three long narrow streaks of the Alga thickly accumulated upon the surface. This was the only accumulation I ever observed out of the China Seas, and we are thus reminded of the "bandes vertes" observed by Chamisso between Teneriff and Brazil, in 1811.

But the *China Sea* appears to be the home of this minute vegetable. Having left Singapore behind, the appearance of sea-dust became an every-day occurrence, in all its remarkable and interesting features. Nearly every day while traversing this sea more or less of it was to be seen, sometimes a mere sparkling appearance, while sometimes, and not unfrequently, the sea was covered with a thick scum of a yellowish-brown colour, like that which settles upon a stagnant pond. The sea in some places was entirely hidden by

the accumulation of the Alga, which, in calm weather, presented the appearance of a regular, smooth, cream-coloured pellicle, thrown up here and there into thick folds and rugosities; and where thickest of a dirty yellow colour, but *never red.* Such a scum would cover the sea for nearly the whole day, with little interruption. But if a moderate breeze were blowing, and the sea were raised, instead of an uniform pellicle, the dust would be arranged in long irregular parallel lines, bands, or streaks, extending unbroken as far as the eye could reach, and always taking the direction of the wind. On one occasion we crossed a single band of this character, the only one seen during the day. When the sea becomes rather rough, the substance is more dispersed, and I have traced the bands under such circumstances with some difficulty. Out of four times that I crossed the China Sea, I observed these appearances, more or less well marked, during three passages. The fourth time was in winter (December), and during the height of the monsoon—the wind very boisterous, and the sea very rough—so that the substance was doubtless so washed and thoroughly dispersed by the waves, as to be indistinguishable amidst the turmoil and foam.

The most northerly point at which I observed its accumulations forming a pellicle upon the surface of the sea was at the north entrance of Formosa Channel, in lat. $25\frac{1}{2}^{\circ}$ N., and the most southerly point was in Rhio Strait, on the equator.

I have described the first specimens observed, from the Indian Ocean north of the line, as presenting under a lens the appearance of a *sheaf* (fig. A), but this peculiar arrangement I did not elsewhere meet with. There were, in fact, two modes of aggregation of the vegetable filaments composing the Alga in question. Everywhere in the China Sea, in the South Indian Ocean, and in the Atlantic, the form presented was that of small cylindrical bundles, more or less pointed at one end, but obliquely truncated at the other (figs. B, C), having an average length of $\frac{1}{8}$th to $\frac{1}{10}$th inch. They were cream-coloured and opaque, and examination with a lens showed that the ends were fimbriated, owing to the component fibres being loose at their extremities. A third form was occasionally mingled with these, but in very small quantities. It was a minute spherical body, solid and opaque, about the size of an ordinary pin's head, bristling with minute rays, like a miniature echinus (fig. G). This form I noticed in the North Indian Ocean, and very rarely in the China Sea, but, although associated with the sheaf- and wedge-shaped Alga, it appeared to constitute a very

infinitesimal proportion of the scum upon those seas. I look upon it as a species of Oscillatoria.

The appearances presented by all these three forms under the microscope are very similar, and the first two apparently identical. The body, whether sheaf- or wedge-shaped, is at first opaque, but gentle pressure shows each bundle to be composed of a dense mass of cylindrical filaments of unequal lengths, combined together and interlacing with each other, forming an intricate network, having the appearance of a complicated basket-work with the ends of the osiers sticking straight out, as when the work is unfinished (fig. D). Each filament is long, and beautifully symmetrical, unbranched, with a rounded extremity, and perfectly even, hair-like outline. The filaments appear to be of equal diameter throughout their entire length, and are filled with a dark-green granular matter, which, before pressure is applied, renders them nearly opaque, and prevents any examination of their structure.

The application of slight compression, however, renders this form of the cells very evident, as well as their arrangement in the filaments. Each filament appeared to be transversely divided by delicate lines, as distinct in character as the wall of the filament, each cell being seen to contain some granules of green matter in the interior, principally clustered about the centre (fig. E). Every filament, then, was composed of a linear series of tubular cells, and was, therefore, truly jointed, like a Conferva, and not like an Oscillatoria, continuously tubular. I nowhere descried anything like an empty tubule which had discharged its contents bodily, nor anything approaching to such an appearance, and, moreover, further continued pressure, after rendering the cells more and more distinct, ended by breaking the filament into distinct cells, some of which presented a rectangular aspect, others a round outline, according as they presented their sides or their ends to view (fig. F).

In neither of these forms did I ever notice anything which could be construed as a movement of oscillation, or indeed of any kind. Neither was there visible any mucilaginous envelope surrounding any of the specimens which I examined, such as is so strongly insisted on by Ehrenberg in the specimens obtained by him in 1823 in the upper part of the Red Sea.

As for the figures given by Montagne in the 'Annales des Sciences Naturelles' (see fig. H), I can only say I cannot recognise them as anything I noticed under the microscope. Their irregular forms offer a singular contrast to the symme-

trical beauty of the filaments when taken fresh from the ocean, and I can only suppose that Montagne's specimens, obtained upon a piece of linen by M. Dupont, had become, in drying, so altered in form that subsequent moistening failed to render them recognisable.

The echiniform body (fig. G), which I consider to be an Oscillatoria, was surrounded by a gelatinous envelope, and was hard and dense in the centre, and therefore opaque On applying gentle pressure, the villous appearance was shown to be due to the free ends of a great number of filaments which intermix with one another in the mass, and formed a minute solid ball. They were unbranched, but twisted around one another, and agglutinated together in a complex manner. While thus engaged in examining them, the filaments one after another suddenly broke up, the little masses of contained endochrome separating from one another, not retaining each its cell-form, as in the case of the Confervæ just described, but rapidly vanishing under my eyes in a smoke-like manner, until, at the expiration of five or six minutes, there was nothing left of the whole ball but a general granular and amorphous appearance.

A species of Trichodesmium was met with by Dr. Hinds, H.M.S. *Sulphur*, in 1826, on the west coast of North America, and again, in 1837, near St. Salvador, and was referred by Mr. Berkeley to M. Montagne, who regarded it as a new species, and named it *T. Hindsii*. This species, he says, was like that of the Arabian Gulf (which has been called *T. Ehrenbergii*), of a fine red colour, and was further remarkable for the strong musty odour which it gave out, and which deserved the name of *olidum*. But as I have, on the one hand, remarked that I have nowhere met with Trichodesmium of a red colour, but always of the same fulvous or dirty yellow, so also I must add that on no occasion have I observed any peculiar smell, even when it has been thickest, nor have I ever heard any one with more acute perception of odour than myself remark anything unusual of that nature.

M. Ehrenberg, in the original article in 'Poggendorf's Annalen,' states that it was not a permanent phenomenon in the Red Sea, but having observed it three times, viz., on the 25th and 30th December, and 5th January, he suggests a periodicity. The appearance and disappearance of the Alga, other things remaining the same, seems to me to be more remarkable than its permanence would have been, but I have no reason to believe that it is in any way a periodic phenomenon in the China Sea, for at any day, on successive days, and at all seasons, I have observed it unchanged. Ehrenberg's speci-

mens, also, he relates, sank to the bottom of the glass during the night, rising again in the heat of the day. I never observed any phenomenon approaching to this. They always floated in the water for the most part, but some few seemed to have greater specific gravity, and sunk to the bottom. In the ocean, I have observed the scum on the surface in early morning and at sunset; but in the cases of the sparkling appearance in the sea, the fasciculi hovered at various depths below the surface, although it was during the heat of a tropical day.

Montagne appends to his exhaustive paper in the 'Annales des Sciences' a series of conclusions on what was known, and questions for further observation, most of which are referred to, and answered in, the present paper; but there still remains the curious fact that although three species are described, *T. erythræum*, *T. Ehrenbergii*, and *T. Hindsii*, they are all three spoken of as blood-red—a colour which I have never seen approached. Again, one of the generic characters of Trichodesmium given both by Ehrenberg and Montagne is "muco involuti," while I confidently state that no mucous envelope characterised the species so abundant in the China Sea, and which I also observed in the Indian and Atlantic Oceans. But, then, it might be said the explanation is easy, viz., that the China Sea Alga is of a different species from that of the Red Sea. I have no doubt whatever that this is the case, but the Alga met with by Darwin near the Abrolhos islets, which gave the sea "a reddish-brown appearance," and which, from his description of it, was apparently the same as that I so abundantly met with in the China Seas, was pronounced by Mr. Berkeley to be *Trichodesmium erythræum*, "the same species with that found over large spaces in the Red Sea." It is true Mr. Darwin describes it as a reddish-brown, but he elsewhere states that the endochrome was of a brownish-green—which is more suggestive of the colour, as I have always seen it. So also the substance seen by Banks and Solander in the neighbourhood of New Guinea was doubtless what I have described, and the name universally given to it by Cook's sailors, viz., *sea sawdust*, exactly expresses its appearance and colour, implying, however, nothing red.

With the exception, indeed, of the observations of Dr. Hinds, the blood-red Alga seems nowhere to have been met with but in the Red Sea and Arabian Gulf, and it would, indeed, be strange if the same Alga was always blood-red in the Red Sea, and yellowish-brown somewhere else. More-

over, Hind's specimens were immediately referred to a new species.

Next to the China Sea, the coast of Australia appears to be the favourite locality for this Alga, though there seems, indeed, to be scarcely any part in the world in which it may not be seen in greater or less abundance.

TRANSACTIONS OF THE ROYAL MICROSCOPICAL SOCIETY.

The Lingual Membrane *of* Mollusca, *and its* Value *in* Classification. By Jabez Hogg, F.L.S., Hon. Sec. R.M.S., &c.

(Read April 8th, 1868.)

By the kindness of F. E. Edwards, Esq., the present possessor of the large and valuable collection of lingual membranes of mollusca made by the late S. P. Woodward, I have been placed in a position to offer a few general remarks upon points which have proved of interest to myself, and, being based upon a careful examination of the objects, I hope will not be unacceptable to the Fellows of the Royal Microscopical Society. It is well known that in any attempts to characterise groups of animals, we find, as we advance from small to large combinations, many of the most obvious external features become of less avail for classification; we are thereby driven to seek for more constant and comprehensive signs in their development than we looked for at the outset. To a certain extent any such effort must be arbitrary and artificial; nevertheless, the necessity for some arrangement is imperatively demanded in this especial, or, indeed, in any, department of natural history presenting the number and variety of the mollusca. Any attempt, however, to make a change in an existing arrangement, or put forth another differing from that already accepted, must be expected to be surrounded with no ordinary difficulties.

I believe it has been authoritatively decided, that in placing the mollusca in generic groupings the distinctive characteristics of the soft parts are no longer to be relied on in making out species. Philippi long ago demonstrated this; and Mr. Jeffreys more recently observes, "that the body or

soft parts of the mollusc, taken without reference to the shell, offers an extremely slight and variable criterion of specific difference." Dr. Gray asserts "that no species of gasteropodous mollusca can be properly placed in a system unless we are enabled to examine the animal, the shell, the operculum, and the structure of the tongue." The shelly covering is a most essential part of a very large number; its structure is hard and dense, and it is, so to speak, the skeleton placed outside instead of within the animal. Or it may be regarded as a pseudo-skeleton, serving, not only to protect the soft parts, but also to keep the whole fabric together, as the internal bony skeleton does the fleshy parts of vertebrata. There is, it should be observed, an equally intimate connection between the shell and soft parts, which is only dissolved by death. The shell, therefore, being the more permanent of the structures of a very large number of mollusca, it is but natural to expect that it should remain, as it, in fact, always seems to be, the most reliable means of classification.

The forms of shells are not only more permanent, but are capable of reproduction without modification. The oldest geological shells are indistinguishable from existing species. "A large proportion of the fossil shells found in the lowest of the Pliocene strata (coralline crag) are precisely similar in every respect to the recent shells of species which still survive bearing the same names; and it is impossible for the most critical species maker to distinguish one from the other. Even their varieties, and montrosities, or abnormal forms, are still repeated."* Dr. Gray, however, does not feel satisfied with the bare examination of the shell in geological formations; he must have *the shell, the operculum, and the teeth;* and as "none of these except the shell can be examined in the fossil state, their position in the various genera must be always attended with more or less uncertainty."† Other competent observers, both on the Continent and in this country, share this opinion.

Cuvier founded his primary divisions of the mollusca on their locomotive organs, and thus obtained the names Cele-

* J. Gwyn Jeffreys, 'British Conchology,' 1865.

Dr. Mörch, of Copenhagen, says—"A monographic research, chiefly based on the teeth of the genera Nassa, Fusus, and Buccinum, found on the coast-lines from the Arctic regions to the equator, would probably be sufficient to prove whether species in each fauna are created originally, or are only varieties dependent on different climates, and would at the same time prove the relations between species of succeeding geological periods."—*Ann. Mag. of Nat. Hist.*, n. ser., vol. xvi, p. 388.

† Dr. J. E. Gray, 'Ann. Mag. Nat. Hist.,' ser. 2, vol. x, p. 413.

phopoda, Pteropoda, Gasteropoda, &c. In a second division he made the respiratory organs a foundation for a systemic arrangement; but this has proved unsatisfactory, for, although in most animals respiration appears to be indispensable to life, special organs are by no means always and absolutely necessary for the purpose. Thus, in some vertebrates are found both lungs and gills, which, according to J. Müller, are not homologous. They sometimes occur together in the same animal, but do not exactly perform the same function; as we noticed in the case of the tadpole described by my friend Mr. Whitney in a valuable paper published in our 'Transactions.' Many of the mollusca, as Cyclostoma, Neritina, and Litorina, are furnished with gills; nevertheless, they live frequently on land and breathe air. Have they, like the land-crab, the power of keeping their gills moist? Again, in those species unprovided with a shell respiration in many individuals takes place almost entirely through the skin; when, however, a shelly covering is fully developed, a respiratory organ of some sort is necessary. In short, it is generally admitted that neither the respiratory nor the locomotive organs offer reliable characters for a primary division.

The operculum is said by some authors to answer to the second hard covering of the bivalves. Lovén regarded this appendage as homologous with the byssus, but this has been shown to be erroneous, since a byssus is found in some few univalves—the *Cyclostoma suspensum*, Swanston, *Planaxis*, Macdonald, *Rissoa parva*, Gray, &c. The byssus of Acaphale is corneous; a calcareous plate forms a plug in Anomia, and a pedicle in Terebratula, which is looked upon as "a secretion of the ventral face of the foot." Later investigations seem to point to the conclusion that all parts of the skin of mollusca can secrete shell, and probably the same remark applies to the operculum.

Some few years have now elapsed since two or three scattered papers in the scientific periodicals of the day announced a new classification of the mollusca, founded on the arrangement of the teeth on the lingual membranes. Gray in this country, and Troschel in Germany, appear to be the most earnestly devoted to the object of carrying out in a systematic manner this scheme of classification. The only paper, however, on the subject, one which is likely to have fallen under the notice of every Fellow of this Society, is from the pen of Dr. Gray, published in Vol. I, n. s., 1853, p. 170, "On the Teeth on the Tongues of Mollusca." I must particularly refer you to this paper, as it offers a somewhat comprehensive

basis of classification. There is also a work published in the German language, of all others the most valuable as a book of reference, it is by Dr. Troschel, of Bohn.* Upon the value of such a system of classification I beg to offer a few remarks.

Although the patterns or types of lingual membranes appear to be, on the whole, remarkably constant, "yet," says Woodward, "their systematic value is far from uniform. It must be also remembered that the teeth are essentially epithelial cells, and, like other superficial organs, liable to be modified in accordance with the wants and habits of the creatures. The instruments with which animals obtain their food are of all others most subject to those adaptive modifications, and can never, therefore, form the basis of a true system.†" Dr. Gray, however, on the other hand, has such confidence in the permanence and importance of the teeth in the economy of these animals, that, "if any considerable modifications appeared in those of two genera which had been referred to the same family, or much more of two species which had been referred to the same genus, it should be concluded that they had been erroneously placed in such close proximity, as this modification must indicate an important difference in the habits and manners of the living species under consideration which had before escaped observation."‡ Professor Lovén, of Stockholm, in a paper on the mollusca of Scandinavia, proposed to divide the lingual bands into fourteen groups, and separate the genera into families and sections, characterised by the number, position, and forms of the teeth; adding, "that the teeth, like the operculum, have usually a structure characteristic of the genera or subgenera, and remarkably uniform throughout some whole families or groups of families." Dr. Troschel, in terms most decided, says—"That if all else were gone, the teeth would afford a reliable means of distinguishing species, and that even the minute differences exhibited in closely allied genera cannot fail in being of great value in the discrimination of critical species." The following table gives the last arrangement proposed by Troschel and Gray:

1. *Tænioglossa.* (Tooth formula 3—1—3.)
   Litorina, Natica, Triton, &c.
2. *Toxoglossa.* (F. 1—0—1.)
   Conus, Terebra, &c.

* 'Das Gebiss der Schnacken zur Berüudung einer Natürlicben classification.' Bohn, 1856—1858.

† 'Woodward's Manual,' p. 450.

‡ 'Ann. Mag. Nat. Hist.,' ser. 2, vol. x, p. 413.

3. *Hæmiglossa.* (F. 1—1—1.)
   Murex, Buccinum, &c.
4. *Rachiglossa.* (F. 0—1—0.)
   Voluta, Mitra, &c.
5. *Gymnoglossa.* (F. ∝ 0. ∝ .)
   Pyramidella, Cancellaria, &c.
6. *Rhipidoglossa.* (F. 00—1—00); or ∝ —1—∝ .
   Nerita, Trochus, &c.

Dr. Gray invented the term *Ctenoglossa* for an order which should include the numerous uniform teeth of the Pulmonata and such like genera, and that of *Ctenobranchiata* for an entirely new family. In the paper contributed to our own Journal he gives a more complete terminology to his divisions, which he illustrates by figures of the principal types. I may add that Mr. W. Thompson described and figured various species of British Helices, Lymnæ, &c., and that Messrs. Alder and Hancock's well-known 'Monographs on the Nudibranchiata' have made us familiar with some of the peculiarities of the lingual membranes of this most interesting family. Some naturalists have proposed to arrange the tongues into four groups, according to the pattern or type of the dentition; and these again have been made to correspond with the four orders founded by Cuvier, on the character of the branchiæ, such as the Pectinibranchiata, the Scutibranchiata, the Cyclobranchiata, and the Pulmonata. The difficulty in this arrangement appears to be that of retaining some of the species in the orders to which they have been assigned; for instance, the Chitons with a gill down each side of the body are evidently out of place among the Cyclobranchiata. The grouping of animals differing much in their general anatomy, as we see in the Purpura and Buccinum, is clearly incorrect. Proceeding, however, with the more special investigation of the tongues of mollusca, it is pretty generally believed that the spines which give so much variety to this organ, although called teeth, are not in reality teeth, or, at all events, not such as we recognise as such in mammals, but rather are corneous and silicated outgrowths, regularly distributed throughout the length and breadth of a muscular ribbon-like membrane, to designate which Huxley proposed the term "odontofore"—tooth-bearing membrane—serving in a vast number of species as an organ of abrasion and trituration or mastication. The outer part of the band and spiny processes being those employed for seizing or securing the food, while those teeth placed in the central portion are used in trituration or mastication. On

making a close examination we find, in by far the larger number of the Gasteropoda, one or more central or median teeth,* with a certain number of laterals, diverging in numerous rows on either side. Some species have, besides, one or more horny mandibles, and even an additional buccal plate, sometimes armed with minute spines.

The horny mandibles of the mollusca are certainly deserving of more attention than they have received, with a view to the elucidation of their affinities. "The mandible is a median plate attached to the bulbus pharyngeus over the oral aperture, serving to divide and pound up the food." So far as I have been able to make out, there are three, if not four, different kinds of mandibles or maxillæ. 1st. Those divided by a median articulation into two equal parts, and covered with fine, acute spiny processes placed in regular rows throughout, as in Cyclotus. 2nd. The horseshoe shaped, with a corrugated or sulcated arrangement, chiefly found in the inoperculata. And 3rd. The smooth, beak-shaped mandible, belonging to Cephalopoda. I believe there is another form, composed of oblique plates set with tessellated or oblong teeth, but this may be only a variation of the first named. The mandible is altogether wanting in carnivorous Pulmonata, or those which merely cut their food in small pieces and swallow it whole; and in marine molluscs it is found only in a few species. It is seen in the young Limax when quite in the embryo state; sometimes before it leaves the egg it is observed to be divided into two parts. In addition to the mandible proper, there is, in nearly all the Tænioglossa, two other lateral plates, or small-sized fixed mandibles, described by Dr. Mörch as "*cheek-plates*," and without cutting edges, "apparently serving only to protect the mouth from injury," or probably serving the purpose of the tongue-bones in vertebrata. Some of the flesh-eaters have the prehensile spiny collar placed quite at the extremity of their proboscis, as in Ancula; in Nudibranchs it is a formidable weapon. In Cephalopods the mandible should rather be termed maxilla or jaw, for it is fairly divisible into an upper and lower jaw.

But to return to the teeth of mollusca. These are mostly

* Some authors—Mr. Jeffreys among the latest—on describing the median part of the band, still apply to it the term *rachis*. The use of this term is objectionable as applied to anything pertaining to an animal membrane. Inasmuch as the word simply means "a spine," and the tongue of the mollusc bears the faintest resemblance to the vertebrate *spine*, and finding also that the term has been long appropriated by botanical writers, it is unadvisable that it should longer be employed when describing the median part of the tongue of a soft-bodied animal.

disposed in longitudinal series. In the Pulmonata there is a single tooth in each median row, with a number of broad and similar laterals disposed in rows on each side, while in other groups the teeth are arranged in three, five, or seven dissimilar rows. Since each row is exactly similar to every other, the system of teeth admits of an easy representation by a numerical formula, in which, when the uncini are numerous, they are indicated by the sign ∞, infinity, and the others by the proper figures. Taking Nerita or Helicina as our type, we designate as *laterals* the broad teeth on each side of the median row, the numerous small teeth on the outside of the band being termed *pleuræ*, and those, still smaller, on this, *uncini;* the latter, found only in certain groups, are usually of extreme tenuity, often beautifully outlined, and frequently serrated.

Dr. Gray's scheme for a classication of mollusca is certainly open to criticism; and it may fairly be asked if any reliable classification can be got out of a union under one formula of so many families as we find grouped in Tænioglossa. Mr. Gwyn Jeffreys, while he expresses a doubt of the value of such an arrangement, admits that the tongues of mollusca "may furnish important characters of such genera as Crepidula, Calyptræa, Patella, &c., which, from their having been long attached to particular places, change the external character of their shells, and thence assume particular forms, which have been regarded as distinct species." Mr. Wilton satisfied himself that *Patella athletica* could be distinguished from the common limpet of our coasts by its teeth, and also that a similar difference is seen between the two Cape species, *P. apicina* and *P. longicostata.* It will not be said that the incongruous group enumerated under Tænioglossa, in which the cuttlefish and river-snail are linked together, at all approaches perfection. Undoubtedly it is a strong point against this, or any other mode of classification, that it places together, in an unusual and embarrassing manner, carnivorous and phytivorous mollusca, "widely differing in habits and anatomical characters." But it may be replied, that in some classes the general characteristics are equally liable to mislead. Take, for example, the slug family, which is made to include Testacella; the slug being almost exclusively a vegetable feeder, while the Testacella is one of the most savage of flesh-eaters well known to pursue its prey, the earthworm, in its haunts with intense voracity and cunning. Even the shell affords little or no protection, being in both alike the merest rudimentary structure, serving only the purpose of a shield when the long,

slender body lies curled up, and even then is insufficient to protect it from the assaults of an enemy. The teeth of the two, however, differ in some important particulars. Those of Limax are arranged in very numerous straight rows, the central one in each of which is the typical tooth, the others passing through certain modifications of form and character as they approach the outermost edge of the band. The whole odontofore is broad, and nearly as wide as it is long; the number of teeth in each row almost equals the number of rows the total of which, in the fully grown slug, reaches, according to Thomson, the enormous number of 28,000. The teeth are very minute, requiring a magnification of at least 200 diameters to resolve the finely curved spines, which are obviously intended only for rasping vegetable matters. The odontofore of *Testacella maugei* (fig. 80) offers a contrast; it is large and wide, furnished with not more than fifty semicircular rows of teeth, gradually diminishing in size as they approach the central row, the median teeth being the smallest, almost rudimentary in their character. The outermost teeth on the band are of great strength, barbed and sharply pointed at the extremity, broader towards the base, and furnished with a nipple-like process which serves the purpose of a kind of lever attachment to the tooth, and connects it with the basement membrane. A set of powerful muscles preside over this organ of destruction, and thus the little animal is enabled to erect its teeth and plunge them into the body of its victim.

It may be said to admit of a doubt whether the voracious feeding Cephalopods are rightly placed by Gray—whether *Sepia officinalis* (fig. 22), with its contractile proboscis, prehensile spiny collar, and odontofore furnished with fifty rows of shark-like teeth, its gizzard for trituration, and its crop for storing, all implying a higher degree of organization, can be classed with such families as Paludinidæ. Another carnivorous species, though not resembling the Cephalopod in general characters and modes of pursuit and destruction, are not the less equally inimical to the mussel and other shell-fish—the whelk family.

The odontofore of *Buccinum undatum* is a rather long, narrow band, bearing a hundred rows of teeth, the medians of which are crested with points bent upon themselves; the laterals are similar, but smaller, hooked and tipped with silica. The proboscis is cylindrical, and armed with sharp, slender spines, which enables the animal by a succession of strokes to penetrate the hardest shell, and in a short time

gain access to the interior. In some respects the odontofore of the whelk resembles that of vegetable feeders.

Chitonidæ, with their horny jaws and long, slender tongues bristling with numerous rows of teeth, tipped with strong, dark-coloured claws, two of which are more prominent than the rest, whose general structural characters closely resemble Patellidæ, find a place among a very different class. Ström nearly a century ago observed both a general and anatomical resemblance between the Coat-of-mail (Chiton) and Limpet (Patella), and noted the fact that, although both were vegetable feeders, and the structure of their shells differ, there is sufficient general resemblance to induce systematologists to place them in one family. Fissurella is evidently a near relation of Patella; it is furnished with nearly the same kind of mandibles as well as odontofore. Cuvier believed Fissurella and Haliotis to be closely allied. Indubitably the latter bears in many of its external characters a striking resemblance to Patella; but if a comparison of its lingual membrane be made, we at once discover much diversity both in form and arrangement. Dr. Gray separates Fissurellidæ from Patellidæ by arranging Dentalium between them; and although Crepidulidæ differ very slightly from Patellidæ, he nevertheless places them widely apart.

Trochidæ, while they resemble in many respects the families just spoken of, the odontofore differs in not unimportant particulars. The median portion of the band is armed with many teeth, and the pluræ with numerous regularly arranged uncini, grow gradually more and more simple and slender as they recede from the central row. In *Trochus cinerarius* (Pl. XI) the medians are large and heart-shaped, with five somewhat similar teeth on either side, and pleuræ armed with ninety uncini. (Formula $\infty\ 5 - 1 - 5 - \infty$.)

Litorinidæ, which are found freely scattered over every quarter of the globe, scarcely differ in any particular, and are almost exclusively vegetable feeders. A few of this family seem to prefer sponges and zoophytes, but this preference is shown only when such structures are loaded with young diatoms or vegetable spores; these they scrape off, and the animal body is left untouched. The lingual membranes of all are alike, *save* in the most unimportant particulars. Osler, in the 'Phil. Trans.,' 1832, tolerably accurately describes this phytivorous family, which, he says, "have three distinct modes of feeding. They browse with opposite horizontal jaws, they rasp their food with an armed tongue stretched over an elastic and movable support, or they gorge it entire. *Trochus crassus* (fig. 48) is an example

of the first, *Turbo litoreus* of the second, and *Patella vulgata* of the third." The tongue of *Turbo litoreus* (a flat strap-shaped organ of more than two inches long) presents three longitudinal ranges of teeth, which recline backwards, and are set like scales, with very little elevation of their edges. In the two outer rows the teeth are single, irregular, crescentic in shape, and set by their convexity. In the middle row the teeth are small, and nearly square in shape. All require a good magnifying power to discover their beautifully reticulated appearance.

It certainly seems somewhat out of place to class the large and bold Triton with Litorina, since the odontofore of the former differs so much from that of the latter. The median tooth is armed with strong recurved cusps, the centre one being long, with five more subdued on either side; the laterals, three in number, are bold, sickle-shaped teeth, one of which is rather broader than the others. The tongue and spiny buccal plates of Triton are certainly indicative of carnivorous habits.

Bulimus (*Bulimus oblongus*) and Helix differ but little either in their anatomical characters or in that of their dentition. The odontofore is a broad band with numerous similar teeth; the forms, however, of the teeth themselves are very varied. Some of the cusps on the teeth of this genus are naturally very pellucid, especially so if the tongue be mounted in balsam, when they frequently escape observation, and owing to this have often been wrongly described. Its mandible somewhat resembles that of a Cephalopod, and it is worthy of inquiry how far the divisions proposed by zoologists are borne out by this part of the organization. The Bulimi are not numerous in Britain; it appears there are but three indegenous species known, and one of them, the most common (*Bulimus acutus*), has been restored by Moquin-Tandon to the genus Helix.

A study of the odontofore of *Cyclostoma elegans* (Pl. VIII, fig. 5) seems to point to an alliance with Trochus (Pl. XI, fig. 48), or some group possessing pleuræ.

In their mode of development Nudibranchs resemble Aplysia, Bulla, and other of these genera. The fry of the latter are almost undistinguishable from those of Tritonia and Doris. The sea-slugs, however, differ in many important particulars from their land congeners. In the first place, although formerly they were thought to be phytivorous, it is now certainly known that a greater part of them prefer animal food.* The odontofore would seem to indicate this;

* Troschel discovered free sulphuric acid in the saliva of *Dolium galea*;

and had not a prehensile collar, with its sharp spines, been found in connection with it, we might without hesitation have pronounced them carnivorous. *Ægirus* is furnished with an additional horny jaw or plate, situated in the buccal lip; it acts in the same way as does the corneous jaw of Limax. The tongue of *Doris tuberculata* is broad, and covered over with nineteen rows of simple recurved teeth. The median tooth appears to be deficient, while the laterals are numerous, about seventy on each side, hooked or recurved, increasing in size as they leave the median line.

Eolis papillosa (fig. 40) the odontofore is narrow, and furnished with a longitudinal series of teeth, curiously articulated, bearing a striking resemblance to the spinal column of vertebrate animals. And thus do we find the structure of the odontofore assisting greatly in our knowledge of the affinities of these animals; it is, indeed, surprising how the characteristics of a shell (perhaps before misunderstood) concur to bear out the affinities indicated by the odontofore; and when the mandible can be made available as an additional distinctive aid to investigation, we may hope at no distant day to discover "the origin of species" among the mollusca.

Many other peculiarities will be observed upon making a close examination and careful comparison of the numerous tongues represented in the plates accompanying this paper.

The Woodwardian collection of lingual membranes has not only furnished materials for the observations submitted to your notice, but has also suggested practical points which I am sure will be of interest, if not of value, to collectors of specimens. The late Mr. J. P. Woodward, assisted by friends, collected upwards of two hundred specimens. Among his contributors I find the names of R. M'Andrew, J. W. Wilton, L. Barrett, Dr. Troschel, Hugh Owen, J. Leckenby, Dr. Ravenel of South Carolina, &c. The specimens are mounted in various media, such as the experience of the preparer and mounter seems to have suggested—Canada balsam, glycerine,

Panceri, 3½ per cent. of free sulphuric anhydride in the same secretion, as well as sulphuric acid in four species of Tritonium,—in a Cassis, two Murices, and an *Aplysia*. This discovery, apart from its special interest, offers a partial explanation of the facility with which the boring gasteropod seems to penetrate shells, &c.

On taking the small quantities at my command of both solid and fluid portions of carnivorous and phytivorous mollusca, and digesting in ether, evaporating and submitting them to Browning's direct-vision microspectroscope, I obtained indications of Chlorophyll and Cruorine. No doubt, if larger quantities of each were taken, and the residue carefully heated, positive bands would appear in the spectrum.

castor oil, Beale's creasote solution, Farrant's glycerine and gum; a few only are prepared dry. Of all the fluids employed balsam is certainly the worst; it spoils or destroys all the details of the more delicate tongues; they are, indeed, rendered so transparent that points of importance not only escape observation, but errors of interpretation are very likely to creep into our drawings and descriptions. By far the most suitable medium for the greater number of tongues is glycerine of various dilutions. The following method of preparing and mounting I find successful:—After having killed the mollusc by drowning in cold water, with or without a few drops of sweet spirits of nitre mixed in it, and having removed as much of the soft parts as possible by repeated washings, or by cleanly dissecting out the tongue with scalpel and forceps, it may be put into a test tube containing a small quantity of a weak solution of caustic potash. In a few days it should be removed, washed with water, and subsequently transferred to a very dilute solution of acetic or hydrochloric acid. On removal from the acid it should be washed with water, and immersed in a solution of glycerine of the strength of one part Price's glycerine to two of distilled water, and finally mounted in a shallow cell in the same solution. Another medium found to answer well in some instances is composed of three parts glycerine solution and one part carbolic acid; the tongue in this instance must be previously immersed in spirits of wine. Another medium is composed of two grains of bichloride of mercury, forty grains of chloride of sodium, fourteen drachms of glycerine, and eight ounces of water. This, if a cloud appear in the solution, must be filtered through fine blotting paper. Some of the tongues of marine species, Cephalopods in particular, require much cleansing and washing before they can be mounted; then it is better to mount them dry in a dark cell.

The catalogue accompanying the preparations shows that Woodward approved of the tongue classification as proposed by Troschel, and he endeavoured to arrange his collection accordingly. He, however, commences with Cephalopods, four only of which are found among the specimens, and these by no means well or very suitably mounted. Pteropods; there is not a single specimen to represent this family; Gasteropods forming nearly the whole of the collection. The Pulmonifera are tolerably well represented. The present possessor of the cabinet having added many specimens, the total number is at the time of writing about 240, inclusive, I believe, of a few sections of shells.

On Fungoid Growths *in* Aqueous Solutions *of* Silica, *and their* Artificial Fossilization. By William Chandler Roberts, F.C.S., Associate Royal School of Mines, and Henry J. Slack, F.G.S., Sec. R.M.S.

(Read May 13th, 1868.)

By kind permission of the Master of the Mint (Professor Graham) the following experiments and observations were made in his laboratory by Mr. Roberts.

By bringing together 112 grammes of silicate of soda, 67·2 grammes of dry hydrochloric acid, and 1 litre of water, and dialysing for four days, a solution of colloid silica, containing 4·9 per cent. of silicic anhydride, remains upon the dialyser, the chloride of sodium and excess of hydrochloric acid having diffused away. This solution becomes pectous somewhat rapidly, forming a sold jelly, which may be dried into a lustrous hydrate by two days' exposure to vacuum over sulphuric acid, or by a more protracted evaporation in air. This solid is remarkably like the opal from Zimapan, but contains 21·4 per cent. of water. There does not appear to be any further loss of water by exposure to air; a specimen dried in vacuo, that had been in air for three years, still retained 21·35 per cent. of water. Natural opals contain from 3 to 12 per cent. of water.

In a specimen of hydrate of silica prepared as above, and allowed to consolidate slowly into a compact mineral mass, Mr. Roberts observed arborescent forms, which, when viewed with the naked eye, bore considerable resemblance to certain formations in moss agates. Examination with a microscope showed that the structure had a vegetable appearance; and on being shown to Mr. Slack, he suggested that it might be an artificial fossil of one of the various forms of mould. In many cases the vegetation appeared in the form of bundles of radiating and branched fibres, such as are shown in Pl. XII, fig. 1. In other instances the fibres were branched, but the radiating character was imperfectly shown. With a magnification of 100 a beaded structure was apparent in most of the threads, and this character was strikingly brought out by higher powers. In many cases the terminal cells were surrounded by spaces, as shown in fig. 2, as if the silica had been eaten away, or reduced in bulk by removal of a portion of its water. These spaces did not exert a refractive power materially differing from that of the adjacent parts.

Mr. Roberts and Mr. Slack determined to investigate the

matter further, employing different solutions of hydrate of silica. Mr. Roberts found that all the air-dried specimens of silica in the laboratory at the Mint contained bundles of radiating fibres varying in diameter from 0·2 mm. to 0·5 mm., and in some cases 1 mm.; and when magnified the fibres resolved themselves into beaded cells. Specimens of the jelly dried in vacuo were quite free from these fibres. Gelatinous silica, stored in completely filled bottles, exhibited no fibres, but they did occur in some other bottles which were only partially filled.

An examination of about fifteen specimens showed that in no case was there any appearance of the passage of colloid silica into crystalline silica.

Mr. Barff, F.C.S., assistant to Professor Williamson, was kind enough to prepare for Mr. Slack a solution containing about 4 per cent. of silica, obtained by dialysis in University College laboratory. In one specimen, which had been exposed for a few days to the air, Mr. Barff noticed threads, which proved to be fungoid. He also found that similar threads were not destroyed by contact with strong (cold) hydrochloric acid, nor even by a mixture of hydrochloric and hydrofluoric acids.

All the specimens of silica solution supplied by Mr. Barff to Mr. Slack, whether kept in bottles nearly full and corked, in bottles containing much air, or in open vessels, exhibited the mildew threads in the course of a week or ten days.

In order to test the aptitude of a solution of pure dialysed hydrate of silica to further the growth of fungoid vegetation, Mr. Slack made the following experiments, selecting silica solutions in which no trace of vegetation could be discovered.

On the 26th March a small tube bottle was nearly filled with the silica solution, a piece of mouldy cheese was placed at the bottom, and the bottle corked. In a second bottle, filled with the solution, a small piece of live moss was placed. The next day the part of the solution immediately over the cheese in the first bottle turned milky, and flocculent-looking projections rose from the cheese. On the third day the solution was completely gelatinized and milky.

On the 27th March a small portion of periosteum from a mouldy bone was placed in a similar bottle and solution. Gelatinization took place as when the cheese was employed. No gelatinization occurred at that time in the bottle containing the moss.

On the 31st patches of mould appeared at the top of the first bottle, and the next day a similar growth was observed at the top of the solution in the third bottle.

On the 2nd April three tubular-looking threads were noticed in the bottle with the cheese. Subsequent examination showed them to be tubes formed by the escape of some gaseous matter; and at a later date Mr. Roberts noticed their resemblance to some appearances in a moss agate in his possession (figs. 4 and 5). As the silica contracted, it formed various lens-shaped bubbles, with remarkably brilliant reflecting surfaces.

On the same day a small mushroom-shaped object was noticed in the bottle with the periosteum, and Mr. Berkely subsequently pointed out its resemblance to *Mucor clavatus*.

On the 6th April the bit of moss exhibited a conspicuous growth of mycelium threads. This bottle, though corked, slowly gelatinized. Another bottle, in which a piece of parsnip was immersed in silica solution, produced a plentiful growth of mycelium threads. When gelatinization had taken place the cork of this bottle was removed, evaporation ensued, and the silica solidified with numerous cracks and fissures. The fungoid threads grew freely from the surface of the silica after partial solidification had taken place, and the process of cracking by slow contraction did not seem always to break the slender threads. Fungoid threads growing out of this partially solidified silica produced little balls of spores in air. A bottle of the solution, into which a little mould from stale beer was placed, was filled in a week or two with fungoid growths, scattered through the silica, which gelatinized slowly. Some silica solution placed in an open evaporating dish, slightly covered with paper to keep out dust, soon exhibited the fungoid threads. It was allowed to gelatinize and solidify. It then presented the appearance of fig. 3.

The preceding experiments show the facility with which moulds will grow in a solution of pure silica in distilled water, and the way in which they may be artificially fossilized.

It is curious to note that such delicate structures as these fungoid and beaded threads are not torn or materially compressed in the process of solidification of the colloid silica. In Mr. Roberts's specimens, in which the solidification took place very slowly, the fungoid plants look in as natural a condition as when they were floating freely in the limpid solution.

Mr. Roberts finds that a jelly containing 5 per cent. of silicic anhydride, 10 mm. thick, will dry, after three weeks' exposure to air, at a mean temperature of 10 C., or 50 F., to a solid lamina 1·5 mm. thick; but when free floating groups of the fungoid fibres are compared with those artificially fossilized in his specimens, there is no evidence that any

similar amount of compression has been experienced by them, and a careful microscopic examination by both authors of this paper shows that only a slight disturbance in the position of some of the terminal cells has taken place.

It would thus seem that the contraction of the gelatinous silica into the solid hydrate differs materially from the conditions that would result from a mechanical pressure acting from without, as when water is squeezed out of a sponge, or from a mere rush of molecules from the outer layers towards the centre.

On a New Form *of* Condenser *with a* Blue Tinted Field Lens. By W. H. Hall, F.R.M.S.

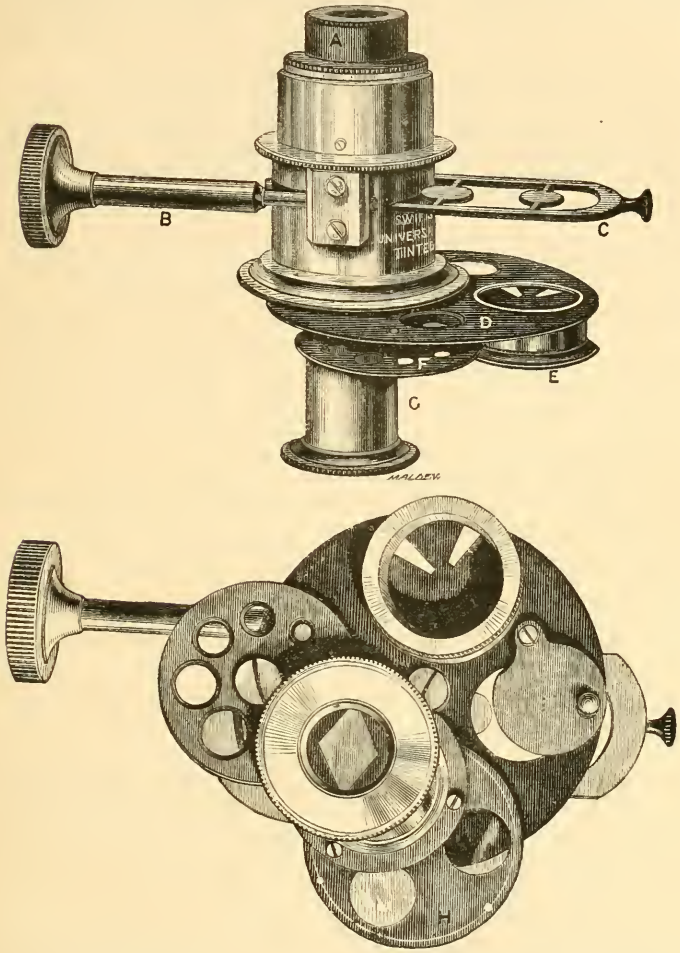
(Read May 13th, 1868.)

Some few months ago I was asked by several of the members of the Cambridge Heath Microscopical Society to recommend a condenser of such a price as to be consistent with the sums paid for the cheap student's microscopes purchased by them; but not finding one suitable for this purpose, I made some suggestions to Mr. Swift, of Kingsland Road, who undertook to carry them out, and has succeeded so well that I have thought it desirable to direct attention to the result.

There are two optical combinations, one—the cheaper—sufficiently corrected for achromatism for ordinary purposes, and connected with a suitable mounting; the other achromatic, and more elaborate in its mechanical arrangements. Both forms are on the table, and will be understood by the engravings attached to this paper.

The under, which may be called the field glass, is a plano-convex lens of low curvature, made, if intended for use with artificial light, of blue glass of sufficient depth of tint to neutralize the yellow rays, and produce a soft daylight effect, which I have found very grateful to the eyes in long-continued observations. A similar shaped lens of colourless glass is provided for solar light; this condenses the light on a deep plano-convex combination of plate and flint glass, having somewhat different curves in the cheaper and more expensive forms, and worked at a much less cost in the one than in the other. The angle of light given by each is, however, the same—about 110°.

Mr. Swift has in hand a new and cheaper form of paraboloid, that will be made to fit and work in the mechanical arrangements of this instrument; it will eventually make



A. Optical combination.
B. Rack adjustment for focussing.
C. Sliding frame with black spots, for dark-ground illumination.
D. Large diaphragm.
E. Rotating cap to carry test stops.
F. Small diaphragm of apertures.
G. Polarizing prism.
H. Selenite diaphragm.
I. Oblique light shutter.

part of the condenser I shall have to mention presently.

The mechanical portions of the condenser consist in the cheap form of an outer tube having a bayonet catch to attach

it to the under plate of the stage of the microscope, and an inner sliding tube within that to carry the lenses, and a diaphragm with perforations for a polarizing prism, spot for dark-ground illumination, and shutter for oblique light. In the more expensive instrument the focus is obtained by a rack-and-pinion adjustment, and the upper part of the tube is pierced so as to admit of a frame, having two central stops, to slide closely beneath the field glass, thereby giving a more intensely dark ground than can be got with the stops at a greater distance from the lenses, and at the same time permitting the polariscope to be used in conjunction with the spots.

The large diaphragm has also two smaller ones revolving upon it—one pierced with a series of holes, gradually increasing in diameter, and the other with three perforations, one open, two containing selenite films so arranged as to rotate behind the polarizer. Lastly, there is a revolving cap to carry stops for the examination of test objects, the stops being made removable at the will of the operator. The various parts requiring it are centered by spring catches.

The special value of this condenser is considered to be—

1. It can be used with marked advantage with objectives from 2 inch to $\frac{1}{8}$th inch; with my Powell and Lealand's $\frac{1}{5}$th and D eye-piece I have easily checked the dots on *P. angulatum*.

2. The remarkable daylight softness produced by the tinted field lens when used with artificial light, also dispensing with the necessity of blue lamp chimneys.

3. It is a very effective spot lens, and dark-ground illuminator, with polarized light.

4. An almost indispensable requisite for polarized light when using high powers with the object mounted in fluid.

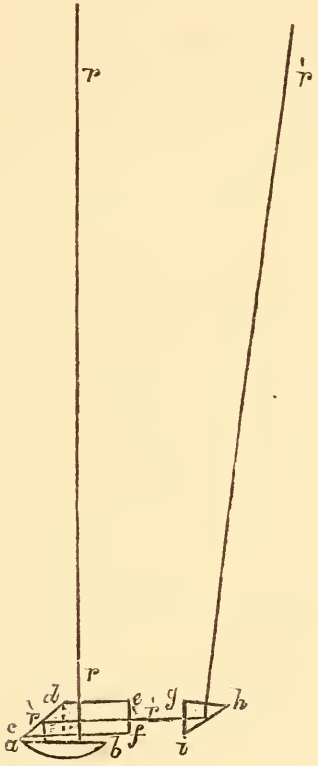
5. And not least important, the ease and rapidity with which the changes from ordinary to oblique and plain or coloured polarized light, with the other combinations I have named, can be made.

That you may have the opportunity of examining the instrument, and judging of its worth for yourselves, I am desired by Mr. Swift to ask the Society's acceptance of one in its complete form, with polarizer and paraboloid, and adapted to the microscopes made by him for the Society.

On the Improvement *of* Nachet's Stereo-pseudoscopic Binocular Microscope. By Charles Heisch, F.C.S., F.R.M.S., &c.

(Read May 13th, 1868.)

At the conclusion of last session Dr. Carpenter brought before the Society Nachet's Stereoscopic and Pseudoscopic Microscope, pointing out its advantages and disadvantages. It struck me that by slightly modifying its construction the disadvantages might be removed, and that it might thus be made to combine to a great extent the advantages of both the Nachet and the Wenham form of instrument. A re-



ference to the subjoined figure, which represents the essential parts of Nachet's instrument, will show the defects to be overcome. *a, b* is the posterior of the objective, *c, d, e, f* a piece of thick parallel glass, ground at one end to an angle

of 45°, the reflecting surface *c, d* being just large enough to cover half the aperture of the objective.

The glass is so mounted that it can be pushed half way across the objective, in which case the reflecting surface *c, d* will be opposed to the left-hand half of the objective, instead of to the right, as in the figure. *g, i, h* is a reflecting prism, the face, *g, i*, being parallel to *e, f*, and *g, h*, at right angles to rays entering the prism perpendicular to *g, i*, and reflected from *i, h*. One body of the microscope is fixed so as to receive the rays *r, r*, which pass from that half of the object-glass not opposed to the reflecting surface *c, d*. The other body is so placed as to receive the rays *r', r'*, which have been reflected from *c, d*, and *i, h*. When *c, d, e, f* is in the position represented in the figure, the effect is stereoscopic; when it is pushed so that the rays from the other half of the object-glass are reflected, the left-hand image is presented to the right eye, and the right-hand to the left eye, and the effect is, of course, pseudoscopic.

The disadvantages to be overcome are these:

1. The unreflected image is seen only through the thick piece of glass *c, d, e, f*, and though, if this be very perfectly worked, the loss in definition is not great, it is still quite perceptible.

2. Owing to its large size, the glass *c, d, e, f* can never be completely removed from the object-glass, so the instrument cannot be used as a uniocular microscope.

3. From the same cause, the prism *g, i, h* must be so far from *c, d, e, f* that the bodies of the microscope must be nearly parallel, which prevents the possibility of using the draw-tubes as a means of adjustment for the difference in the width of different persons' eyes, which adjustment is obtained by making *g, i, h*, together with the body over it, move in a horizontal direction nearer to or farther from *c, d, e, f*. This arrangement gives rise to two inconveniences:—First. If the eyepieces are so made that both images shall be in focus when *g, i, h* is in any given position, the reflected image is thrown quite out of focus as soon as it is moved. Second. It is difficult to make a fitting to carry the prism and the body of the microscope which shall not become loose by wear, in which case the instrument is at once out of adjustment.

To remedy this defect, I first reduce the glass *c, d, e, f* to a simple reflecting prism by cutting it down the dotted line from *d*. The direct image is now seen without the intervention of any glass; by appropriate mounting, the prism may still be moved from one side of the object-glass to the

other, to produce either stereoscopic or pseudoscopic effects, and on account of its small size can be withdrawn from the object-glass altogether into a small recess, and thus convert the instrument into a uniocular microscope, thus removing the first two objections. The reduction in the size of the first prism enables the second prism *g*, *i*, *h* to be brought close into the object-glass, and thus the second body can be placed at such an angle to the first that the draw-tubes can be used, as in Wenham's instrument, to regulate the distance of the eyepieces. The second prism and body may thus be made fixtures, and not only the danger of getting loose by work be done away with, but if the eyepiece be once properly adjusted for focus, they afterwards move simultaneously, and can be focussed together as in an ordinary instrument, thus removing the third objection.

It may be asked, what advantages does this form of instrument possess over that in ordinary use? I was at first inclined to think, that beyond being a pretty illustration of the manner in which the eyes may be deceived by presenting to them the wrong side of an object, not any. But closer acquaintance with the instrument has convinced me, not only that this is of practical value, but that there are other advantages besides. When there is a very slight difference in the planes in which two objects or parts of an object lie, it is difficult, even with the binocular instrument, to say if two parts, *a* and *b*, are exactly in the same plane. One thinks *a* may be above *b*, but does not feel sure; if, however, on moving the prism from one side of the object-glass to the other, a distinct difference is observable, the doubt is converted into a certainty. Another advantage is that, owing to the prism *g*, *i*, *h* having an independent adjustment, it is easier to get a perfect coincidence in the position of the two images, together with a perfect reflected image, than where no independent adjustment is possible after the prism is once ground. This perfect coincidence of position is of comparatively little importance to those who have strong muscles to the eye, but to those who, like myself, have a weak internal rectus muscle, it makes all the difference between comfort and discomfort.

I may mention that I have met with several persons who have great difficulty in using the ordinary binocular microscope, who use the instrument now brought before the Society with ease and comfort.

On a Reversible Compressorium *with* Revolving Disk.

By Samuel Piper, F.R.M.S.

(Read June 10th, 1868.)

Frequent use of the ordinary live-box has made us all fully aware of its attendant evils. Valuable specimens (seen perhaps for the first time) are frequently crushed in the endeavour to arrest their active movements, thus showing us the necessity of devising means of applying a gradual pressure which will prevent this danger, and also be of service where objects are required to be flattened when under observation.

This requisition has been completely met by the compressorium of Messrs. Ross; there is, however, one great disadvantage attending this form, that of being *non-reversible*, which is of the utmost importance, as it is only possible to examine one side or surface of the specimen, instead of all its parts.

There are two or three reversible forms at present in use, all of which, however, necessitate removal from the stage of the microscope, to be readjusted or turned over, and in consequence, the object has again to be sought for, and if small, this is not only an uncertain and tedious operation, but an unnecessary tax upon the eyes and patience.

In the arrangement I am about to submit to the Society, I think I may say the advantages of both kinds are combined, with far greater facilities in regard to reversibility and ease of manipulation, a single motion being sufficient to show both surfaces of the object almost instantaneously, without the slightest disarrangement of position or of focus, and in addition, it is furnished with a revolving disk for the examination of dry objects.

It is available for all modes of illumination, the Lieberkühn requiring the addition of a small movable arm of blackened metal carrying a central disk or spot, which can be turned aside when not employed, as in Liston's dark walls. It is also applicable to objectives of any depth.

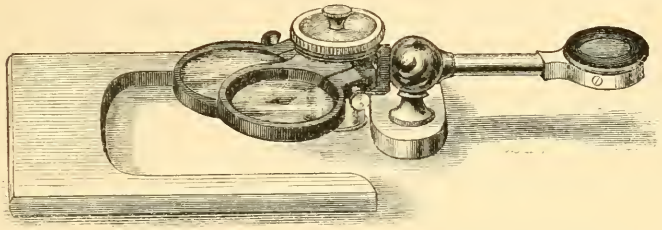
This compressorium consists of two circular metal frames, the inner surface of each being grooved (in a similar manner as in the mounting of spectacles) to receive a thin glass, which is held in position by means of a thumb-screw, and in event of breakage, fresh glasses may be instantly applied by the most inexperienced, by simply reversing the screw and dropping another into the recess.

For the purpose of placing the object in position, the upper disk is made to turn aside by a lateral movement, after which it is again brought above, and pressure applied by a milled-head and fine screw, which depresses the top frame to the point of contact, or as near as may be desirable.

This movable frame is carried on a cylinder, within which is a closely-fitting spring box containing the screw, surrounded by a spiral steel coil, which separates the glasses when it is required to withdraw the specimen.

These tubes working together like the parts of a telescope secure a perfectly parallel motion, while the opposing screw and spring produce a remarkably even pressure.

The box carrying the frames is mounted on an arm which freely turns, for the purpose of reversing the object. At the



opposite end of the box is placed the revolving disk, formed by enclosing within a metal ring an inner tube filled with cork, the edges of the tube being turned over, that of the outer ring in the form of a flange, which being milled is easily turned in any direction. The arm is supported upon a metal pillar, made to rotate on a stout brass frame or stage-plate, three inches by two, which is cut away in the middle to admit the under-stage illuminating apparatus.

This compressorium may be procured of Mr. Swift, 15, Kingsland Road, to whom I have given the right of manufacture.

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TRANSACTIONS OF THE ROYAL MICROSCOPICAL SOCIETY.

DESCRIPTION OF PLATE I,

Illustrating Dr. Guy's paper on the Sublimation of the Alkaloids.

Fig.

1.—Arsenious acid, with four-sided prisms.

2.—Arsenious acid, with triangular notched plates and globules of metal.

3.—Corrosive sublimate.

4.—Cantharidine, showing two forms—*a*, with short plates; *b*, with long jointed plates.

5.—Solanine.

6.—Veratrine, showing detached crystals—*a*, under a high power; *b*, under a lower.

7.—Meconine.

8.—Cryptopia.

9.—Hippuric acid.

10, 11, 12.—Three crystalline deposits from test fluids—10, from solution of bichromate of potash ($\frac{1}{100}$); 11, from solution of carbazotic acid ($\frac{1}{250}$); 12, from solution of nitro-prusside of sodium ($\frac{1}{100}$).

DESCRIPTION OF PLATE II,

Illustrating Dr. Guy's paper on the Sublimation of the Alkaloids.

Fig.

13, 14, 15.—Sublimates of strychnine—13, fine-feathered crystal ($\frac{1}{5000}$th grain); 14, crystals in forms *a* and *b*, found in the same sublimate; 15, sublimate from a deposit from a solution in benzole.

16.—Sublimate of strychnine treated by a solution of bichromate of potash ($\frac{1}{100}$); plates of various forms, single and in groups.

17.—Sublimate of strychnine, treated by a solution of carbazotic acid ($\frac{1}{250}$), showing hooks or claws, scattered and grouped.

18.—Sublimate of morphine, treated with the same reagent, showing part of margin of dry spot.

19.—Sublimate of brucine, treated with the same reagent, showing root-like forms.

20.—Sublimate of morphine, curved elements contrasting with the nearly straight elements of strychnine (fig. 13).

21.—Globular sublimate of morphine, showing crystalline forms in the globules.

22.—Morphine with hydrochloric acid ($\frac{1}{20}$).

23.—Morphine with spirits of wine.

24.—Morphine with liq. ammoniæ.

25.—Morphine (smoked sublimate), with distilled water. Winged (fly-like) crystals.

Tuffen West, ad nat del

W West imp

1.
2.
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DESCRIPTION OF PLATE III,

Illustrating Mr. Gorham's paper on a peculiar Venation in the Leaves of the Umbelliferæ.

Fig.

1.—Pinna from bi-tri-pinnate leaf of *Æthusa Cynapium.*

2.—Pinna from leaf of *Silaus pratensis.*

3.—Pinna from bi-tri-pinnate leaf of *Œnanthe crocata.*

4.—Pinna from leaf of *Torilis Anthriscus.*

5.—Pinna from leaf of *Chærophyllum temulum.*

6.—Small dissected leaf of *Carum Carui.*

7.—Leaf of *Eryngium maritimum.*

8.—Terminal pinna from dissected leaf of *Peucedanum officinale.*

(All the figures enlarged three diameters.)

DESCRIPTION OF PLATES IV & V,

Illustrating Mr. Newton's paper on the Anatomical Differences observed in some Species of the Helices and Limaces.

PLATE IV.

Drawn from nature by E. T. N.

Fig.

1.—Reproductive organs of *L. maximus*.
2.— „ „ *L. Sowerbii*.
3.— „ „ *Arion ater*.
4.— „ „ *L. agrestis*.
5.—Backward turn of the intestine of *L. maximus*.
6.—Cæcum of *L. flavus*.

From drawings by G. Busk, Esq., F.R.S., &c.

A. Spermatozoa, coiled and uncoiled.
B. Granular cells.
C. „ with nuclei.
D. Transparent cells.

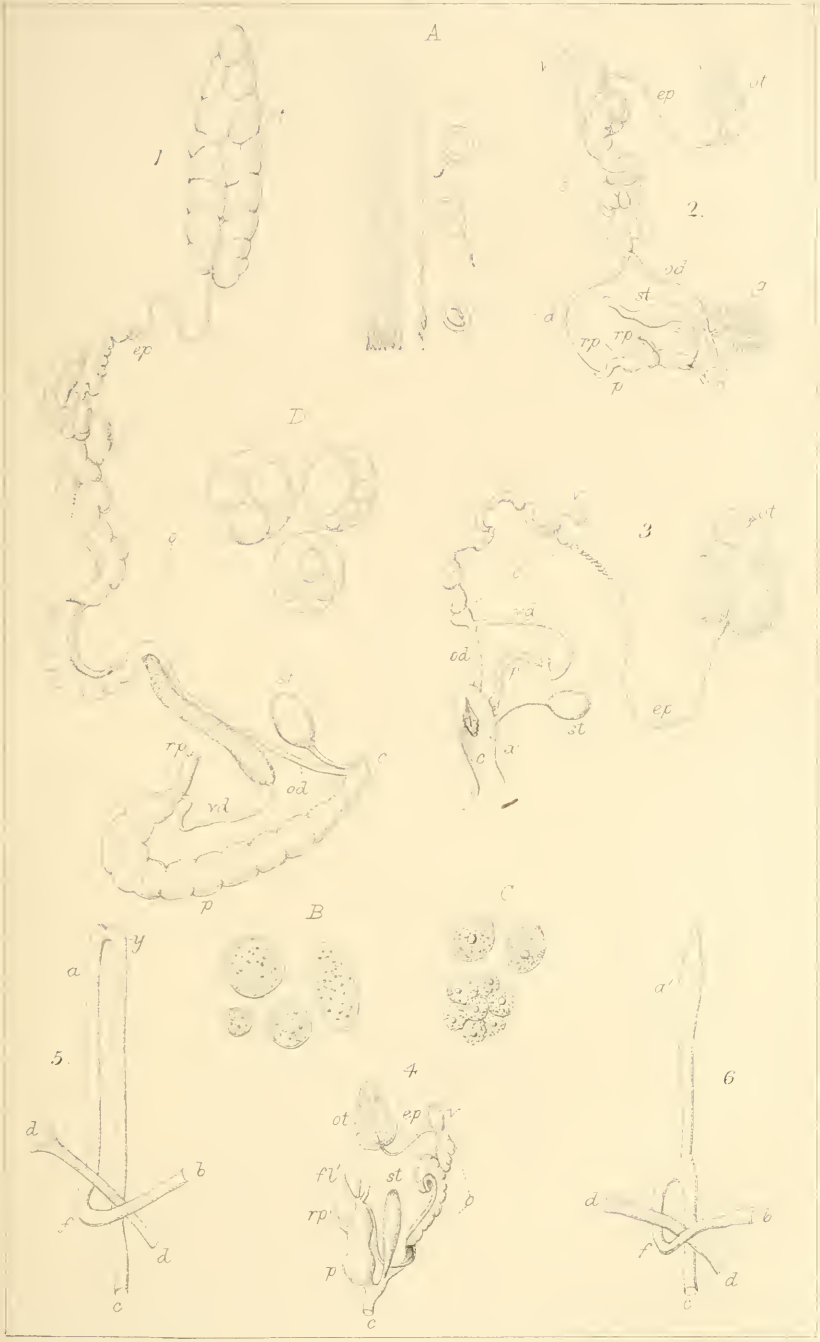
PLATE V.

Drawn from nature by E. T. N.

7.—Reproductive organs of *H. aspersa*.
8.— „ „ *H. nemoralis*.
9.— „ „ *H. rufescens*.
9*a*.—The dart-sacs of *H. rufescens* enlarged.
10.—Reproductive organs of *H. cantiana*.
11.— „ „ *H. virgata*.

References to the Lettering in both Plates.

ot. Ovotestis.
ep. Epididymis.
v. Vitellary, or tongue-shaped gland.



E. T. Newton del. Tuffen West sc.

W. West imp.

E. T. Newton del. Tuffen West sc.

W. West imp.

o. Convoluted tube, in which are combined the oviduct and vas deferens.
od. Oviduct after its separation from the vas deferens.
vd. Vas deferens.
p. Penis.
rp. Retractor muscle of penis.
rp'. Additional muscle in *L. Sowerbii*.
c. Cloacal chamber.
g. Multifid vesicles.
d. Dart-sac.
fl. Flagellum.
fl'. Trifurcate gland of *L. agrestis*.
st. Spermatheca.
adst. Accessory tube to spermatheca.
x. Fleshy body at opening of oviduct in *Arion ater*.

References to Figs. 5 *and* 6 *only*.

a. Backward turn of the intestine in *L. maximus*.
y. Its constriction.
a'. Cæcum occupying a similar position in *L. flavus*.
b. Intestine cut through near the liver.
e. Rectum.
dd. Great retractor muscles.
f. Curl of intestine round the muscles.

DESCRIPTION OF PLATE VI,

Illustrating Mr. Tatem's paper on New Infusoria.

Fig.

1.—*Cœnomorpha convoluta.*

2.—Basal view of same.

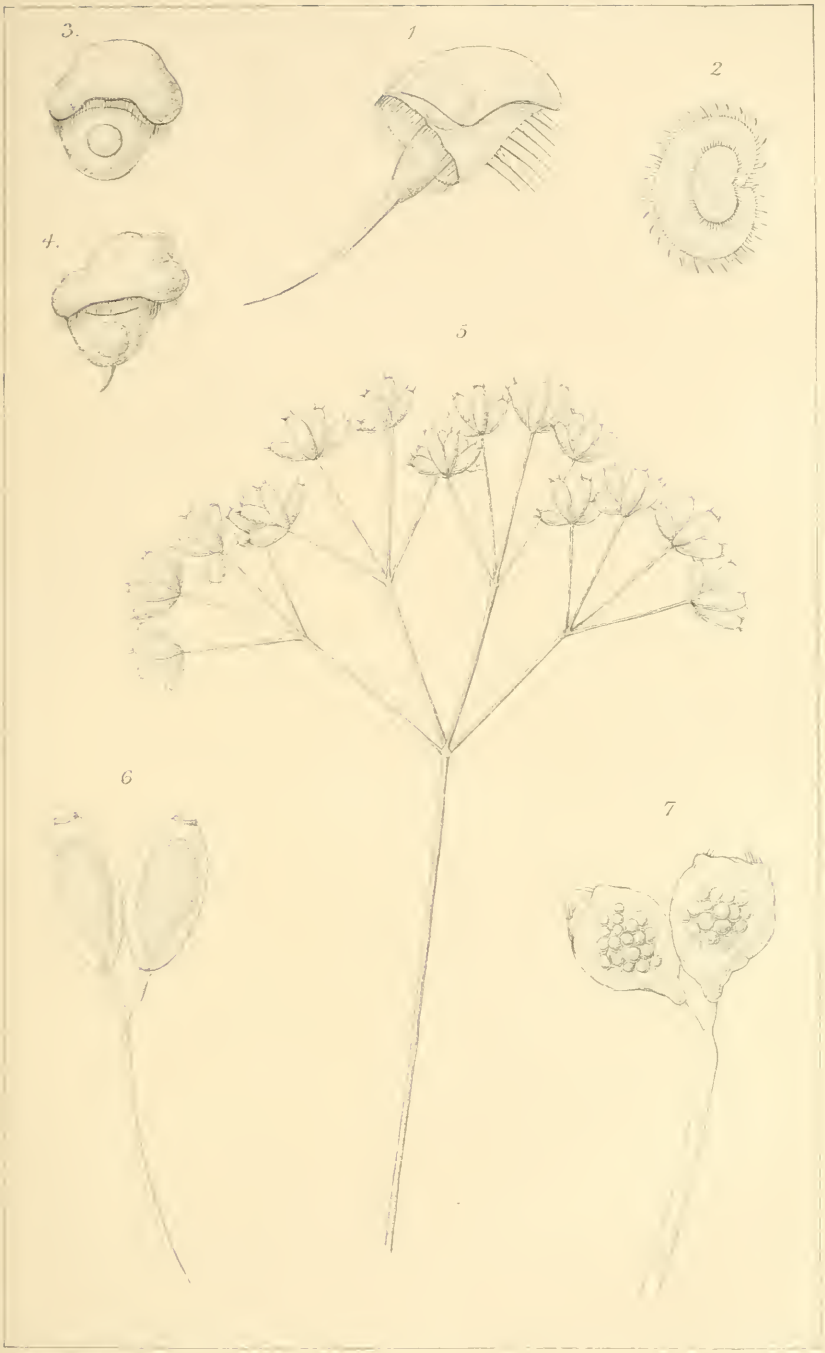
3 & 4.—Suspected early stages of same.

5.—*Epistylis umbellatus.*

6.— „ *marinus.*

7.— „ *ovalis.*

(All the figures magnified 300 diameters.)



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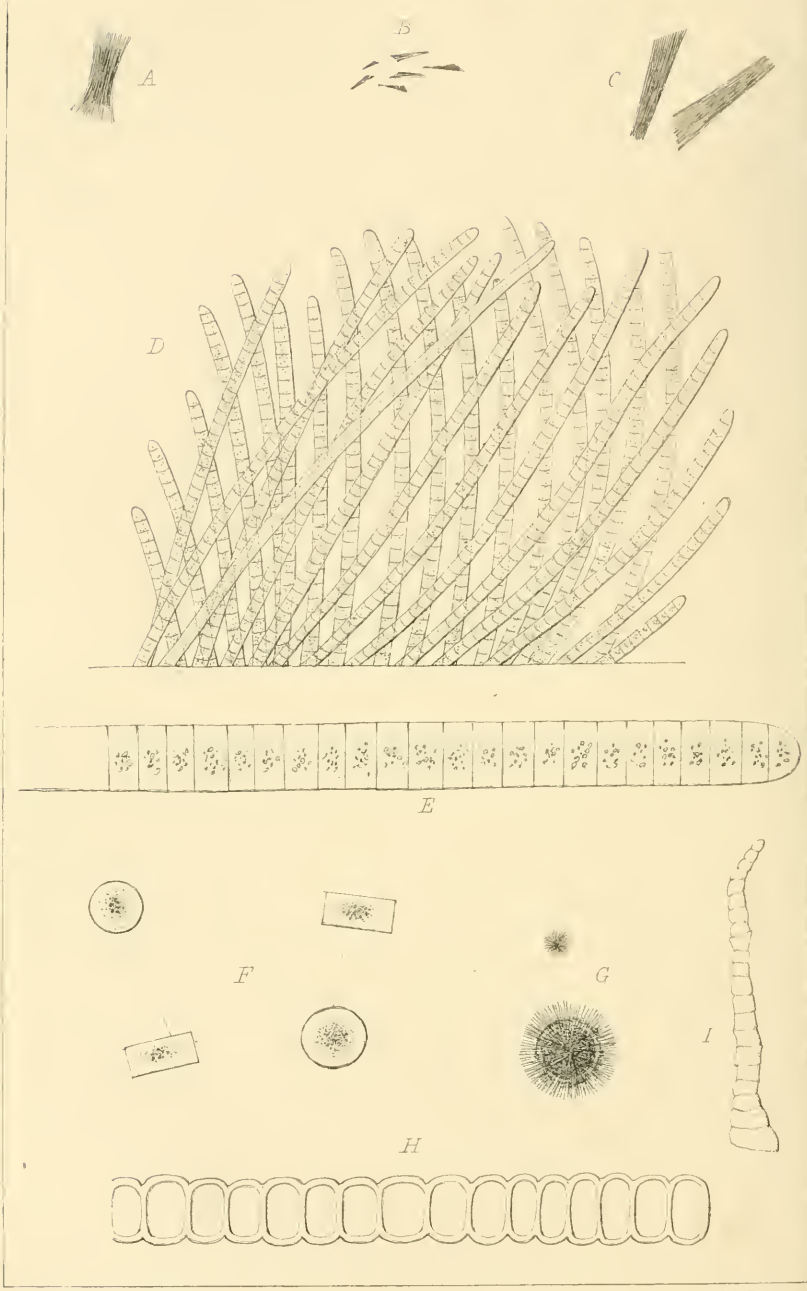


C Collingwood del T West sc

W West imp

DESCRIPTION OF PLATE VII,

Illustrating Dr. Collingwood's paper on the Microscopic Alga which causes the Discoloration of the Sea in various parts of the World.

Fig.

A.—Sheaf-form of *Trichodesmium*, from the Northern Indian Ocean (seen with a lens).

B.—Ordinary wedge-form of ditto, characteristic of the China Sea (nat. size).

C.—Ditto (seen with a lens).

D.—The fimbriated ends magnified, showing the loose, simple, filamentous structure.

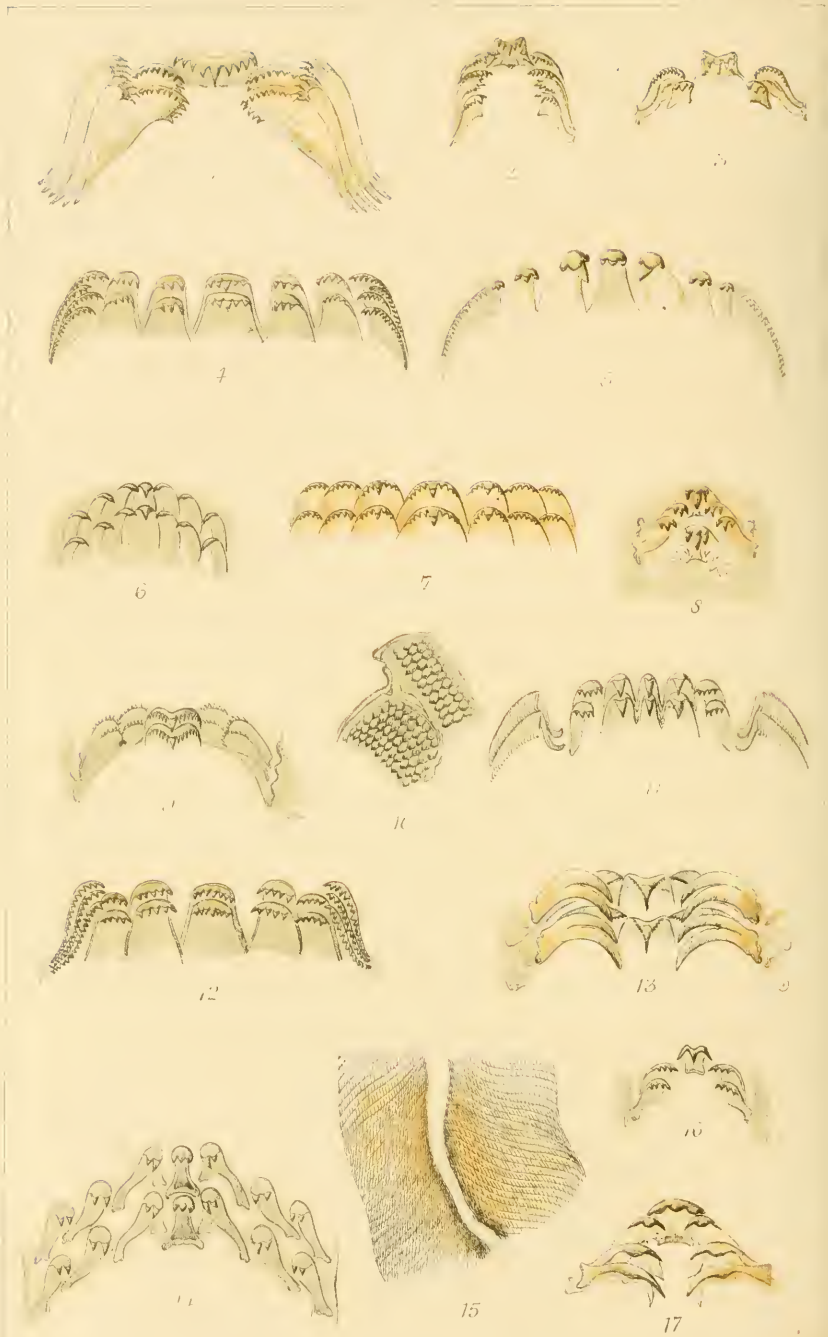
E.—A single filament (highly magnified).

F.—Single cells in process of disruption.

G.—*Oscillatoria*, found in conjunction with *Trichodesmium* (nat. size, and with a lens).

H.—A normal filament of *Trichodesmium Ehrenbergii* (from Montagne).

I.—Extremity of a filament of *Trichodesmium Hindsii* (from Montagne).



W.F. Mapes del. Twist sc.

W. Nest sc.

DESCRIPTION OF PLATES VIII, IX, X, XI.

Illustrating Mr. Hogg's paper on the Lingual Membranes of Mollusca, and their Value in Classification.

[It should be understood that the arrangement of the plates in no way serves to indicate Troschel's classification; the collection of specimens, although large, was found to be inefficient for the purpose. The descriptions are taken in the order of numbering, and as the illustrations were arranged by the artist.]

PLATE VIII.

Tænioglossa (For. 3—1—3).

Fig.

1.—*Io.* (*melania*) *spinosa*, U.S. Specimen prepared and mounted in glycerine by Dr. Troschel. Median reflexed and cuspid, central cusp prolonged, with four shorter on either side. 1st lateral broad, top reflexed and denticulate; shaft narrow. 2nd narrow, reflexed, denticulate. Another of the family Melaniadæ, Pl. IX, fig. 18.

2.—*Bithinia tentaculata*, Suffolk. A small and narrow band, not more than a tenth of an inch in length. Median produced outwards, reflexed, denticulations numerous. 1st lateral reflexed, denticulate. 2nd and 3rd narrower, and finely denticulate.

3.—*Litorina ulvæ*, Brit. A small and narrow band. Median produced outwards, reflexed, denticulate; centre cusp long. 1st lateral widens out at top, reflexed, denticulate. 2nd lateral smaller, denticulate. 3rd simple, hooked, slightly produced base.

4.—*Cyclostoma carinatus*, Mauritius. Median bold and slightly produced, reflexed; centre cusp strong and apical, with two or three on either side. 1st lateral resembles median; cusps not so bold. 2nd lateral reflexed and denticulate. 3rd reflexed, numerous denticulations.

5.—*Cyclostoma elegans*, Brit., N.B. Median approaching the pyramidal form, reflexed, denticulate; centre cusp rather long. 1st lateral produced outwards, reflexed; centre cusp strongly apical, with two or three smaller on either side. 2nd lateral narrow, not so much produced, denticulate. 3rd finely serrated; more properly, uncini numerous.

6.—*Paludina decisa*, River Potomac, U.S. Narrow band, with numerous minute teeth; medians and lateral differing slightly. Median reflexed, denticulate. Laterals similar, narrower and smaller denticulations.

7.—*Paludina vivipara*, Brit. Mounted in balsam, and rendered thereby much too transparent. Median subquadrate, produced outwardly, reflexed, denticulate. 1st, 2nd, and 3rd laterals narrower, reflexed, and denticulate.

8.—*Lacuna puteolus*, Brit. Median broadest, five-cuspid. Laterals, 1st and 2nd denticulate; 3rd simple, hooked, omitted in drawing.

9.—*Valvata cristata*, Brit., Suffolk. Very minute band, about one fiftieth of an inch. Median broad, reflexed, denticulate. Laterals similar, reflexed, and denticulate.

10.—Mandible or buccal plate of *V. cristata* in two equal parts, armed with numerous rows of simple spines.

11.—*Cistula catenata*, Germany, Dr. Troschel. Median small, narrow, reflexed; cusp apical. 1st lateral bold; cusp much produced. 2nd lateral broad, denticulate; uncini numerous. This, named by Gray Cistula, evidently belongs to Cyclostomidæ.

12.—*Tropidophora articulata*, Rodriquez. So named by Troschel; clearly belongs to Cyclostoma. A large narrow band of well-arranged teeth. Median large, subquadrate, produced outwards, reflexed, denticulate. 1st and 2nd laterals similar, denticulate. 3rd, numerous fine serrations extending down outer border.

13.—*Pileopsis Hungaricus*. Belonging to Calyptræidæ (bonnet-limpets), found chiefly on oysters. Dentition is seen to be almost identical with *velutina*. Drawn from my friend Mr. F. Walker's collection.

14.—*Hybocystis gravidum*, Manlmein. It appears doubtful whether this should not be named *Cyclotus rugatus*. Median broad, produced outwards, tridentate. 1st lateral produced outwards, bidentate. 2nd lateral similar, but shorter. 3rd still smaller, teeth diminishing outwards.

15.—*H. gravidum*. Mandible in two equal parts; numerous rows of finely acute spines, gradually diminishing.

16.—*Lacuna vineta*. Median quadrate, reflexed, tridentate. 1st and 2nd laterals produced outwards, denticulate; 3rd believed to be simple, but cannot be made out in specimen.

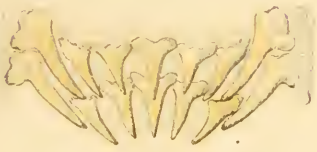
17.—*Cyclophorus aquilum*, Burmah. Belonging to operculated land-snails. Odontofore a narrow, elegant ribbon. Median reflexed, tridentate. 1st lateral looks inwards, tridentate; 2nd and 3rd sickle-shaped; base flattened out, and set firmly in basement membrane. Mandible large and bold, covered with acute spines placed in numerous regular rows.

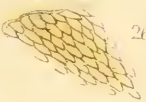
PLATE IX.

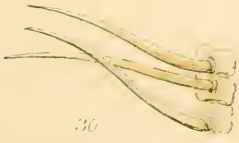
Tænioglossa.

18.—*Melania multilineata*, R. Potomac. A long and minute band of fine teeth. Median reflexed, and cuspid; centre cusp long. 1st lateral reflexed, broad on the upper edge, and multicuspid; 2nd and 3rd reflexed, multicuspid.

19a







19.—*Valutina levigata.* Belonging to Naticidæ. Median reflexed, multicuspid, central one of which is much produced. 1st lateral turned to median, multicuspid, the inner cusp much produced; 2nd and 3rd simple, hook-shaped. Two rows of laterals seen.

19*a.*—Mandible divided, and forming two plates of divergent rows of acutely pointed teeth.

20.—*Aporrhais pes-pelicani,* Vigo Bay. Placed by Forbes with Cerithiadæ; clearly an error. Median subquadrate, reflexed, seven-cuspid; centre one prolonged. Laterals simple, hooked teeth, very long and slender, closing over median.

21.—*Octopus vulgaris,* Vigo Bay. Median much produced, cuspid, centre one long and acutely pointed, while that on either side is much subdued; articulated with each other like the bones in the vertebral column of vertebrates. 1st lateral similar, but much smaller, cusps looking inwards; 2nd lateral similar, but large and broad; 3rd lateral slightly curved inwards, and set in membrane like a thorn on stem of rose. Two rows shown.

22.—*Sepia officianalis,* Brit. Median simple, slightly hooked. 1st and 2nd laterals similar; 3rd lateral much larger and bolder, claw-like. From Mr. F. Walker's collection. *Sepiolia atlantica,* a small inferior specimen, being the only one in the Woodwardian collection.

23.—*Ampullaria urceus,* Trinidad. Median broad, subquadrate, or boat-shaped, reflexed, seven-cuspid; central cusp strongly apical, on either side three smaller cusps. 1st lateral broad, reflexed, cuspid; centre one prolonged, with two shorter on either side. 2nd and 3rd simple, claw-shaped.

24.—*A. effusa?* Brazil, so very nearly resembles the former that the same description applies to it.

25.—*Carinaria cristata.* Median reflexed, tricuspid. 1st lateral a transverse plate, with a slightly hooked apex turned to base of median; 2nd and 3rd simple, sickle-shaped.

26.—*Cassis sabaron.* Median subquadrate, multicuspid, decreasing in size from central cusp. 1st lateral hooked, denticulate; 2nd lateral denticulate, produced towards base; 3rd lateral simple, sickle-shaped.

26*a.*—*C. sabaron.* Mandible divided, covered with fine spines.

27.—*Loligo media,* Tenby. Median bold, and produced at base; tricuspid, centre one long and acutely pointed, while that on either side is much subdued. 1st lateral similar, looking inwards; 2nd and 3rd laterals hooked or simple.

28.—*Cyprœa Arabica.* Median broad, subquadrate, reflexed, cuspid; central one longest, and two much subdued on either side. 1st lateral hook-shaped, cusp prolonged; 2nd and 3rd simple, hooked. Half only shown in drawing. Somewhat more closely resembles Cyclostoma than that of its congener.

29.—*C. Europœa,* Galway Bay. Median cuboidal, produced base, reflexed, multicuspid; centre cusp longest, with three or four smaller on either side. 1st lateral denticulate; 2nd and 3rd simple, hooked.

30.—*Cithara* (*mangelia*) *gracilis.* Specimen imperfect. Median probably lost in mounting. Lateral simple, slender tooth, terminating in a dilated base, which is firmly set in membrane.

Hæmiglossa (For. 1—1 –1).

31.—*Fusus antiquus*, Brit. Odontofore narrow, and at least an inch and a half long. Median broad, base produced; three subequal denticles or spines. Lateral, three subequal spines, the outer one curved, hook-like, and longer.

32.—*F. gracilis*, Scotland. Median small, with three denticles or spines, centre one long. The medians are placed on a narrow muscular band, which gives a ladder-like appearance to it. Lateral, two unequal spines. Odontofores of *F. gracilis* and *F. Islandicus* are exactly alike, while that of *F. antiquus* agrees with *Buccinum undatum;* that is, the median is broad, with the margin extended on each side in a truncated form. The whole tongue is surrounded by a sheath of muscular fibres.

33.—*Cominella maculosa*, New Zealand. Median nearly semicircular, armed with three equal spines; lateral, two unequal spines bent outwards; terminal one longest. Clearly belonging to Nassidæ.

34.—*Nassa reticulata*, Brit., Folkestone. Median crescentic, crowded with numerous nearly equal spines, central one slightly the longest. Lateral armed with two spines triangular in shape; the formula of spines 2—11—2. The family to which this belongs was founded by Stimpson on an odontological basis, "on account of its arched form and numerous denticled medians." Macdonald pointed out another characteristic, which distinguishes Nassa from Buccinum—"the absence of smaller denticles or spines between the two principal fangs of the laterals."

35.—*Murex trunculus*, Malta. Median, base produced, armed with fine spines alternately long and short; lateral a simple spine, slightly curved.

36.—*Purpura hæmastoma*, Madeira. Median slightly curved, narrow, armed with numerous spines; centre long and acutely pointed; two subdued, an outer one rather longer. Lateral simple, hooked, produced at base.

37.—*Mitra fusca*, Madeira. Odontofore narrow, linear series of similar teeth. Median armed with seven spines, centre longest; laterals numerous, gradually diminishing outwards.

38.—*Cymba-olla* (*Vetus* of Gray), Gibraltar. A single row of teeth boldly set on a strong muscular band, tridentate, and acutely pointed.

39.—*Dendronotus arborescens*, Greenland. One of the family Æolidæ. Median subquadrate, reflexed, apical, pyramidal; laterals numerous similar reflexed teeth. Formula of band 10—1—10.

40.—*Æolis papillosa*, Aberdeen. Mouth furnished with a horny mandible, divided into two parts, and united above by a ligament. Odontofore semicircular, armed with numerous rows of simple spines; tapers off to the stomach or gizzard.

41.—*Aplysia* ——, Vigo Bay. Forty rows of divergent teeth. Median, broad, produced at base, reflexed, tricuspid; centre cusp prolonged and serrated (not well seen in the drawing). Laterals similar, produced, reflexed, tricuspid, numerous.

42.—*A. hybrida*, Torbay. Seventy-two rows of divergent teeth. Median, a truncated cone, much produced at base, reflexed and denticulate; laterals numerous, similar teeth.

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V. F. Maples del. F. West sc.

W. West imp.

42 *a*.—Mandible of same divided and covered throughout with rows of irregular spiny processes.

43.—*Oncidoris* (*doris*) *bilammellata*, Brit. 2—1—2. Median small, reflexed cusp. 1st lateral claw-like, remarkably strong, and produced at base; 2nd smaller, similar, hooked.

44.—*Scapander lignarius*, Vigo Bay. Odontofore, median apparently wanting; laterals bold, flattened out, rib-like; very strong, opaque, dark-coloured teeth. Buccal plate composed of three calcareous plates, triangular in shape. "Gullet in the form of a corn-sack; often found distended with scores of a little bivalve *Mactra subtruncata*. The sack gradually empties itself into the gizzard."

PLATE XI.

Rhipidoglossa (00—1—00).

45.—*Phasianella Australis*, Port Curtis. Family Turbinidæ. Odontofore remarkably bold. Medians semicircular, ten reflexed cusps, the two centre of which are the larger, diminishing in size as they approach uncini, the first six of which are remarkable for the strength of their hooks; uncini about sixty in number, hooked, diminishing outwards.

46.—*Imperator imperialis*, Bombay. Medians reflexed and hooked; centre one produced at base; five on either side similar. Uncini numerous hooked, serrated, diminishing outwards.

47.—*Phasianella pullus*, Brit. A dark-coloured short band, contrasting with preceding specimen. Medians similar, reflexed or hooked; uncini numerous, hooked, diminishing outwards.

48.—*Trochus crassus*, Madeira. Medians eleven; central bold and produced, base forming alæ; reflexed, denticulate. Uncini hooked, numerous, between seventy and ninety, diminishing outwards.

49.—*Tr. fragarioides*, Malta. Medians eleven, centre largest, hooked; uncini numerous, hooked, denticulate, diminishing outwards.

50.—*Turbo Australica*. Medians eleven, reflexed, hooked; uncini numerous, simple, reflexed, gradually diminishing.

51.—*Tu. rubicundus*, New Zealand. Medians eleven, reflexed hooked teeth considerably produced at base, increase in size as they leave the central tooth, and meeting a larger and bolder hooked-shaped tooth. Uncini numerous, diminishing outwards, becoming fine small teeth.

52.—*Neritina zebra*, Brit. Median small, subquadrate, base produced. Uncini, 1st large, transverse, subtriangular, folded on itself. 2nd and 3rd suboval, transverse, giving a currycomb appearance to the arrangement. Uncini about sixty, reflexed, serrated, and symmetrically arranged in semicircular rows.

53.—*Nerita albicilla*, Mauritius. Median small, subquadrate, reflexed. 1st uncini articulating with median; subtrapezoidal. 2nd, which has a shaft and a head, the transverse portion of which is trapezoidal; the shape, however, is rather remarkable, and not very constant throughout. Uncini numerous similar teeth, hooked, diminishing outwards.

54.—*N. communis*, West Indies. Odontofore smaller than former and teeth finer. Median minute, reflexed, apical. Uncini, 1st large, transverse, flattened as it approaches the 2nd, which is small and reflexed. 3rd subopaque, trapezoidal; head large, having the appearance of a double-headed hammer placed on the flat, the extreme portion being much produced and hooked. Uncini numerous, small, hooked, diminishing outwards.

55.—*N. Mauri*, West Indies. Median subquadrate, reflexed, apical, narrow towards base. Uncini, 1st broad, reflexed; 2nd small, reflexed, and narrow; 3rd large, subopaque, trapezoidal, having a broad, hood-shaped head. Uncini numerous, hooked, diminishing outwards; an elegant band, well suited for polarized light. This group show a close affinity to Helicina, the formula properly $\infty\ 3 - 1 - 3\ \infty$.

56.—*Haliotis tuberculata*, Guernsey. Median subquadrate, base produced outwards, reflexed. Uncini, 1st resembles a shoulder-girdle, articulating with a subopaque tooth of remarkable strength, hooked; this is followed by others similar but smaller. Uncini about sixty, first four very large, gradually diminishing outwards. The specimen is mounted dry, and well displays itself under polarized light. There are several other specimens of the same in cabinet; the bold shark-tooth-like appearance of the first of the uncini is very striking. The odontofore strongly resembles that of Trochus.

(*To be continued.*)

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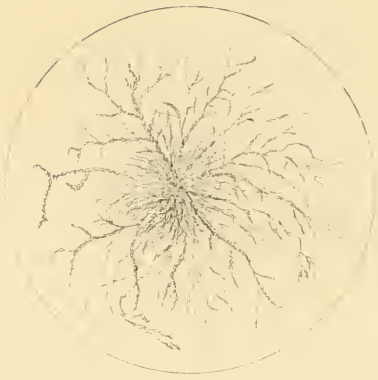

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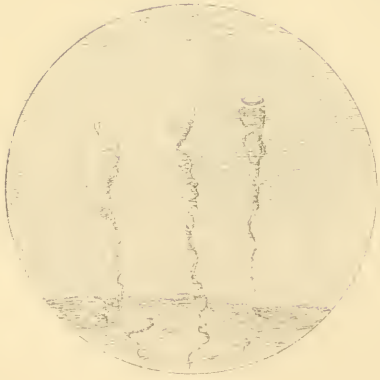
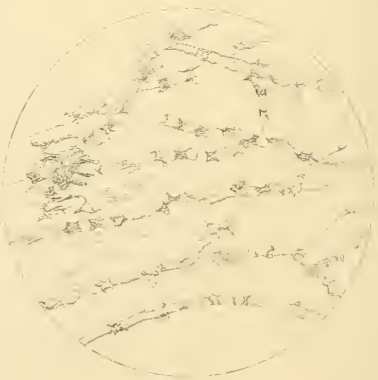
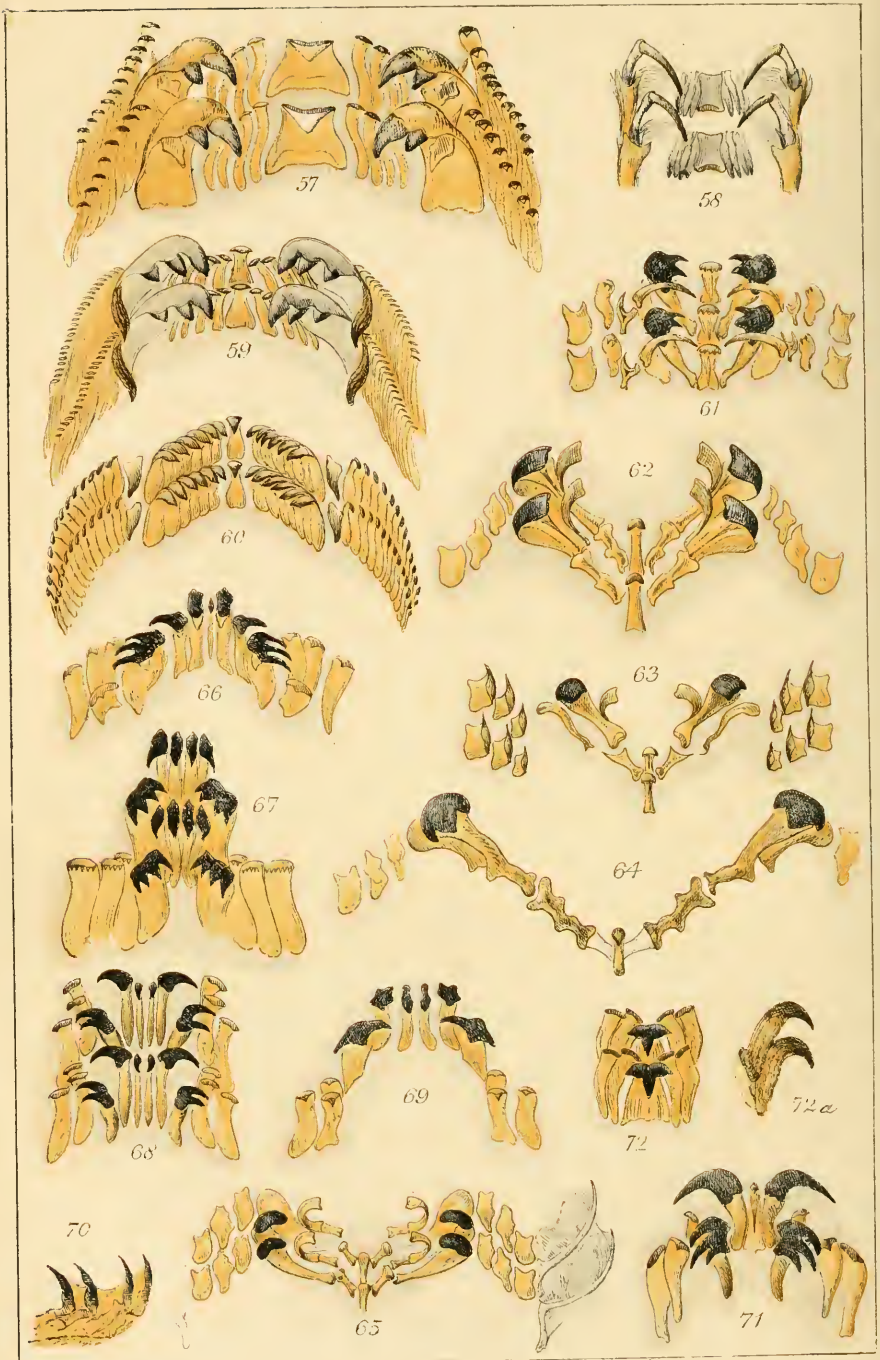




Trans. Micr. Soc. Vol. XVI. N.S. Pl. XII.



DESCRIPTION OF PLATES XII & XIII.

Illustrating Mr. Hogg's paper on the Lingual Membranes of Mollusca, and their Value in Classification. (pp. 93—104.)

PLATE XII.

Rhipidoglossa (00—3—1—3—00).

Fig.

57.—*Pharmophorus Australis*, New Zealand. Odontophore bold, and an inch and a half or more in length; colour deep orange. Median broad, reflexed, and produced outwards; four smaller teeth reflexed on either side. Pleuræ armed, 1st remarkable for its strength, reflexed, tricuspid; numerous, smaller gradually diminishing outwards. The teeth have considerable strength, and appear to belong to an animal feeder.

58.—*Fissurella reticulata*, Mazellan. Median subquadrate, reflexed; three smaller teeth reflexed on either side. Pleuræ armed, two strong sickle-shaped teeth, flanked by smaller. Specimen rendered too transparent by the balsam mounting.

59.—*Fissurella magella*. Odontophore differs in some respects from former. Median broad, slightly produced outwards; on either side are three reflexed teeth, supported by a bold, strong tooth, tricuspid, the shaft of which appears to narrow off and bend on itself; flanked by numerous smaller teeth, inner border serrated.

60.—*Margarita Greenlandica*, Greenland. Median reflexed, serrated; on either side five or six much reflexed teeth; flanked by a wedged-shaped rudimentary tooth, slightly reflexed, and numerous smaller ones diminishing outwards.

61.—*Chiton fulvus*, Vigo Bay. Odontophore long and narrow. Numerous rows of strong hooked teeth. Median small, reflexed, dentate. 1st lateral small, reflexed. 2nd tricuspid, strong, head clump-shaped, shaft long and narrow. 3rd hooked, tusk-like, flanked by four subquadrate teeth set in a tesselated manner in the basement membrane.

62.—*Chiton cinereus*, Red Sea. Median narrow, reflexed; the shaft, which is long, articulates with the next tooth, this again with the next, a large and bold bicuspid tooth. There appears to be a double row of black glistening teeth, hooked, with plain cutting edges, separated by a central band, probably muscular; four teeth, subquadrate and slightly reflexed.

63.—*Chiton piceus*, Antilles. Median small, reflexed, extremity articulating with a narrow tooth, the other end of which is connected with a strong tricuspid tooth, and flanked by three teeth, reflexed, symmetrically placed on the basement membrane.

64.—*Chiton echinatus*, Valparaiso. Odontophore long and narrow; an inch and a half in length by one fifth of an inch wide; a good deal of colour, orange-red. Median narrow, reflexed; articulating with an irregular-shaped tooth, and also connected with a strong-hooked tricuspid tooth, and this again is flanked by five small subquadrate teeth, the outer of which is the largest. Basement membrane dense, and the central part appears to be made up of a set of muscular bands, crossing and recrossing each other at right angles.

65.—*Chiton* (*undulatus?*), Birmah. Mounted dry, and showing many points of interest. The medians—indeed all the teeth—are observed to be erect and hooked, or reflexed. Pleuræ armed, first and second have a chisel-shaped cutting edge; third, a black-coloured dense tooth, is armed with two or three strong cusps, and flanked by three or four slightly reflexed teeth, symmetrically placed on the membrane, a portion of which is shown in the drawing.

66.—*Patella spinosa*, Cape. The odontophore in this species appears to take the semicircular form, the median is much subdued in some it is said to be wanting. It is, however, quite rudimentary, and scarcely possible to say what the exact form is. Median rudimentary. Pleuræ armed, 1st small, narrow, reflexed; 2nd hooked; 3rd dense, tricuspid; flanked by three subdued or rudimentary teeth, reflexed.

67.—*Patella pellucida*, Brit. Numerous small pellucid teeth, on a narrow band. Median apparently wanting. Pleuræ armed, 1st and 2nd similar, reflexed, or hooked; 3rd broad-headed, with some three or four or hooked denticulate.

68.—*Patella guttata*, Vigo Bay. Odontophore very long; exceeding four inches in length, with 280 rows of teeth. Median much subdued. Pleuræ armed, 1st narrow, reflexed; 2nd larger, hooked; 3rd broad, bold, tricuspid, flanked by three translucent, slightly reflexed teeth.

69.—*Patella crenata*, Madeira. Odontophore broader and shorter than former specimen. Median much subdued or wanting. Pleuræ armed, 1st and 2nd reflexed; 3rd broad, hooked, tricuspid, flanked by two or three similar teeth.

70.—*Patella radiata*, Brit. Odontophore seen in profile. Teeth long and slender, hooked, placed in a radiating series, all similar in appearance; three similar on outer portion of band.

71.—*Patella denticulata*, Cape. Median small and narrow, reflexed. Pleuræ armed, 1st dense, clump-headed, with two or three strong cusps subdued, hooked; 2nd large, bold, tricuspid; 3rd similar, tricuspid, central cusp much produced; flanked by three small reflexed teeth.

72.—*Lepeta cæca* (*Patella* or *Acmæa cæca*,), Greenland. Median reflexed, hooked, and acutely pointed. Pleuræ armed, 1st narrow, reflexed; 2nd reflexed, similar. Odontophore minute and narrow. Teeth set in separated bands of membrane, formula of which appears to be 2—1—2. *a* Medians seen in profile.

81.—*Glandina truncata*, South Carolina. Medians much subdued; flanked by numerous rows of strong, slightly curved teeth, firmly set in membrane by a nipple-like process. Odontophore very like that of Testacella.

82.—*Testacella maugei*, Brit. Medians much subdued; flanked by numerous rows of strong barbed pointed teeth, curved, increasing in size gradually outwards; strong nipple-like articulation projecting from shaft.

83.—*Stomatella imbricata*, Australia. Odontophore presents a fine feathery appearance. Medians bold, hooked; flanked by semicircular rows of closely arranged teeth, slightly curved and acutely pointed.

84.—*Scalaria Trevelyana*, Shetland. Odontophore very minute, closely resembling Bulla. Medians small, rudimentary; flanked by numerous rows of simple curved teeth.

84*a*.—Mandible, *S. Trevelyana*. Horny, in two equal portions, the upper part only armed with spines.

85.—Mandible, *Bulimus multifasciatus*. Horny, horse-shoe shaped; odontophore of the genus nearly resembling Helicidæ. In nearly all we find a broad band covered by numerous rows of similar teeth, slightly curved and acutely pointed, presenting little or no variation either in form or character. The Helices, although well represented in the Woodwardian collection (fifteen excellent specimens), demand no special notice.

Corrigenda in last Number.

Page 94, last line of text, *for* Celephopoda *read* Cephalopoda.
„ 96, foot-note, bottom line, *for* 'Ann. Mag. Nat. Hist.,' &c., *read* 'Quar. Jour. Micros. Sci.,' Vol. I, N.S., p. 175.
„ 97, line 36, *after* recognise *strike out the words* as such.
„ 97, line 40, *for* odontofore *read* odontophore. Make same correction in pp. 100—103, and description of plates.
„ 103, foot-note, last line but one, *for* heated *read* treated.
„ 107, line 10, *for* Mr. Berkely *read* Rev. M. J. Berkeley.

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ORIGINAL COMMUNICATIONS.

On Polymorphism *in the* Fructification *of* Lichens. By W. Lauder Lindsay, M.D., F.R.S. Edinburgh, F.L.S. London.

About ten years ago I made the secondary or complementary reproductive organs of Lichens a subject of special study, submitting to careful and repeated microscopical examination several thousand specimens from all parts of the known world. The fruits of these researches have as yet only been *partly* published, and that mostly so far as relates to the *higher* Lichens. I was struck with the discovery of many instances of what I have been since led to regard as *Polymorphism* in the fructification—*plurality* in the reproductive organs—of Lichens. I refer here more especially to the *occurrence in the same species of more than one form of Spermogonium or Pycnidium.* I hesitated, however, to publish my results for various reasons, and, *inter alia*, because—

I. The observations in question, if correct, are a novelty in lichenology.

II. I distrusted the correctness of my observations, referring the multiple forms of Spermogonia and Pycnidia in question to various *Fungi* unknown, which did not exhibit their ordinary fructification in the specimens examined by me.

But since that date I have repeatedly met with instances of the same multiple forms of secondary fructification in connection with *Lichens* only; my comparative study of Lichenoid Fungi has led me every year to discover further and closer links of connection between the Fungi and Lichens; I see less and less reason to doubt that the same plurality of reproductive organs which characterises *Fungi* may to a less extent equally characterise *Lichens;* and I have been more and more led to assign the subjects of my observations to *Lichens,* in connection with which they occur, rather

than to Fungi, which exhibit none of their other and more usual forms of fructification. I can no longer, therefore, hesitate in at least calling the attention of botanists to the subject, in order that observation may be directed to the groups of organs in question, with a view to the confirmation or correction of my results as the issue may prove.

It may be that, as Nylander suggests, the organs which I refer to *Lichens* as multiple forms of Spermogonium or Pycnidium are to be assigned rather to *Fungi*. But if such assignment is to be agreed to, it must be made on much stronger grounds than those advanced by that individual, though experienced, Lichenologist; especially seeing that my observations appear to have been so far confirmed by those of Fuisting in Germany* and Gibelli in Italy†—according to Professor de Bary of Halle.‡ Until it is proved that the subjects of my present remarks belong to Fungi, with which I have never seen them connected, I prefer assigning them to the lower Lichens, with which I have—sometimes repeatedly—found them associated, and in the same relative position with the recognised Spermogonia and Pycnidia of Lichens.

The solution of the question is, however, beset with difficulties: whereof the principal is probably the fact that the Spermogonia or Pycnidia in question sometimes or frequently *occur by themselves*, without association with sporidiiferous apothecia or perithecia, whether of Lichens or Fungi. This group of isolated secondary reproductive organs may be held to be illustrated by the old pseudo-genera *Pyrenothea* and *Thrombium*, which all Lichenologists are agreed, I think, in referring to *Lichens* as either Spermogonia or Pycnidia. The subjects of my present remarks are indistinguishable in any of their essential characters from these genera, and are, I believe, quite as much entitled as they to be assigned to *Lichens*. The puzzling group known to the older writers as *Pyrenothea* contains, I believe, various forms both of Spermogonium and Pycnidium — sometimes referable to the same species (*e. g.*, *Lecidea abietina*), sometimes to different species, especially of genera of the *Verrucariaceæ*, *Lecideaceæ*, and *Graphideæ* (*Arthonia* and *Opegrapha*). Indeed, I regard it as an illustrative group of the organs which are the subject of this communication. It includes the following

* Vide footnote, p. 9.

† Vide footnote, pp. 7 and 9.

‡ 'Handbuch der Physiologischen Botanik,' by Prof. Hofmeister: Section on "Morphologie und Physiologie der Pilze, Flechten, und Myxomyceten," by Prof. de Bary: Leipzig, 1866, p. 276.

types of secondary reproductive organs—whether these are to be designated *Spermogonia* or *Pycnidia:*

I. White-pruinose, distinct, comparatively large tubercles, *e. g.,* in

Pyrenothea leucocephala.
P. vermicellifera.

II. Black, lecidiiform, distinct, also comparatively large organs, *e. g.,* in

P. corrugata.

III. Minute or microscopic, black, punctiform or papillæform conceptacles—by far the commonest form, *e. g.,* in

P. aphanes.
P. rudis.
P. byssacea.

Another source of confusion is to be found in the fact that not a few Lichenicolous (parasitic) *Micro-Fungi* occupy the positions usually occupied by Spermogonia or Pycnidia, from which, moreover, they are indistinguishable externally, *e. g.,* species of the genera *Sphæria* and *Torula.* But the latter are distinguishable by their sporidia or spores, or by other characters supposed by fungologists, on very insufficient grounds frequently, to separate Fungi from Lichens. Confusion may arise in the same way from lichenicolous (parasitic) *Micro-Lichens,* which are apt to be confounded with Spermogonia and Pycnidia, *e. g.,* species of *Verrucaria* or *Microthelia, Tichothecium* or *Pharcidia, Phæospora* or *Endococcus.*

A third source of difficulty is the varying definition of the terms "*Spermogonium*" and "*Pycnidium,*" and the conflicting views as to the relation which the one organ bears to the other, more especially in respect of function. The two highest living authorities on the subject of Lichen-reproduction, Tulasne and Nylander, differ as to the nomenclature of the secondary reproductive organs of *Peltigera,* which, according to the former, are *Spermogonia,* to the latter, *Pycnidia.* Many of the organs which I regard as Pycnidia are included by Nylander and other lichenologists among Spermogonia; while Tulasne regards as Spermogonia the conceptacles which, in association with *Lecidea abietina,* I am disposed to denominate Pycnidia. Hence it is an obvious necessity to the understanding of any question affecting the secondary reproductive organs of Lichens that an author should render clear and intelligible his distinction between the groups of organs respectively designated

by him *Spermogonia* and *Pycnidia*. The distinction which I recognise—and hereto append—is simply an *anatomical* one —one of convenience. Hereafter it may prove to be coincident with a *physiological* difference; but as yet the function of neither Spermogonium nor Pycnidium has been satisfactorily demonstrated or determined.

Anatomical or Structural Distinction between Spermogonia and Pycnidia.

Externally indistinguishable, being similar as to site, size, form, and colour; verrucæform, papillæform, or punctiform conceptacles, generally black, sometimes white-pruinose; interior—of same or of a different colour, or subhyaline.

I. *Spermatia.*

1. *Form.*—Generally linear and cylindrical; long in proportion to their breadth; sometimes in exceptional cases split into two after being shed from their sterigmata; of regular form; simple; straight or curved.

2. *Size.*—Generally minute, especially as regards their transverse dimension, compared with stylospores; sometimes divide into two; otherwise uniform; frequently atomic (and then mostly regularly ellipsoid or subspherical).

3. *Number.* — Usually in myriads.

4. *Colour.*—Always hyaline—devoid of colour.

5. *Texture.*—Solid and homogeneous.

6. *Site.*—Borne on apices

I. *Stylospores.*

1. *Form.*—Generally some modification of spherical [oblong-ellipsoid, pyriform, oval]; frequently broad in proportion to length; variable and irregular; sometimes bears a relation to that of the sporidium; sometimes multicellular and septate.

2. *Size.* — Usually larger in all dimensions; variable.

3. *Number.*—Usually less numerous than the spermatia.

4. *Colour.*—Sometimes pale yellow, though usually colourless.

5. *Texture.*—Vesicular or cellular; heterogeneous; contents frequently oily, or granular, or both.

6. *Site.*— Borne on the

or sides of Sterigmata; in the case of compound Sterigmata, many from each "Arthrosterigma."	apices only of the Basidia, one from each Basidium.
7. *Origin.*—Given off from the cells constituting the sterigmata, by a process called by Nylander "Spiculation," whereby the cell-wall becomes protruded into a spicule, which is ultimately detached by gradual constriction of its base.	7. *Origin.*—Given off from the Basidium-cell or tube, by a process called by Nylander "Progemmation," whereby new terminal or apicial cells are developed from or upon other older or basal ones.

If it can be proved that *spermatia* are *solid*, and *stylospores hollow* bodies, it may be admitted that the process of separation in the two cases essentially differs. But in all other respects the processes in question appear identical or similar.

8. *Function.*—Absence of all germinative faculty, so far as known.	8. *Function.*—Nylander assigns the power of germination. Berkeley always speaks of stylospores in Fungi as "naked spores"—as secondary spores capable of germination; and he distinguishes in some Sphæriæ, Pycnidia from Spermogonia, by observing whether the terminal cellules are or are not *capable of germination.* The fact and function of germination may exist; but in Lichens it still requires proof. I have not observed it myself, nor am I aware of any record of such an observation by others.
9. *Associated substances.*—Oil-globules never intermixed.	9. *Associated substances.*—Oil-globules frequently and copiously intermixed.
II. *Sterigmata.*	II. *Basidia.*
1. *Form.*—Simple or compound; latter—known as "Arthrosterigmata"—consist of a few or many superimposed cellules of varying	1. *Form.*—Always simple or unicellular; usually linear and cylindrical; each bearing at its apex a single stylospore; comparatively uniform.

length and breadth; frequently of short, roundish, or oblong, articulated cellules, each of which bears at its apex or side a spermatium; frequently more or less ramose, sometimes only at base; variable.	
2. *Size.* — "Arthrosterigmata" frequently long; variable.	2. *Size.* — Usually short; comparatively uniform.

The chief forms of *polymorphism*, or *plurality of fructification*, I have apparently observed *in the same species of Lichen* are the following:

1. More than one form of *Spermogonium.*
2. More than one form of *Pycnidium.*
3. *Pycnidia* in addition to *Spermogonia;* or *Spermogonia* in addition to *Pycnidia.*
4. *Pycnidia* instead of *Spermogonia.*
5. *Spermatia* and *Sporidia* in the same conceptacle.
6. Different sizes and forms of *Spermatia* and *Sterigmata,* or of *Stylospores* and *Basidia.*

Multiple forms of the reproductive organs I have met with chiefly in the *lower* Lichens, in species, *e. g.* of the genera *Verrucaria, Strigula, Stigmatidium, Trachylia, Calicium, Arthonia, Opegrapha, Graphis, Lecidea, Abrothallus, Lecanora.*

But I have found them also in a few of the *higher* Lichens, *e. g.* in species of *Parmelia, Roccella, Alectoria.*

The following short catalogue of species in which I found deviations from, modifications of, or additions to, the ordinary reproductive organs, with an enumeration of these deviations, modifications, or additions, will probably suffice to illustrate the general subject of my present communication, and to indicate the direction in which future observation is likely to prove useful, either by correcting the errors of previous authors, or by confirming and extending their results:

I. Genus *Verrucaria.*

V. Taylori, V. chlorotica, V. nitida, V. epidermidis, V. biformis. Two or more forms of secondary reproductive organs [Spermogonium or Pycnidium.]

V. gemmata. Spermogonia and Pycnidia.

V. glabrata. Two forms of Spermatia and Sterigmata.

V. atomaria. Spermatia and Sporidia in same Perithecium.

I made apparently the same observation in *Sphæria Lindsayana*, a New Zealand species;* and Gibelli, in Italy, records the occurrence of Spermatia in the asciferous Perithecia of several *Verrucariæ*.†

II. Genus *Arthonia.*

A. cinereo-pruinosa. Two or more forms of Spermogonia.

A. pruinosa. Pycnidia.

,, var. *Spilomatica.* Two forms of Stylospores and Basidia.

A. astroidea. Spermogonia and Pycnidia.

,, var. *Swartziana.* Two forms of Stylospores and Basidia.

III. Genus *Opegrapha.*

O. herpetica, O. vulgata. Two or more forms of Spermogonia.

O. atra, O. varia. Pycnidia.

IV. Genus *Lecidea:*

L. parasema, L. dryina. Two forms of Spermogonia.

L. luteola, L. petræa, L. anomala, L. disciformis, L. albo-atra, L. Cladoniaria. Spermogonia and Pycnidia.

L. enteroleuca. Pycnidia in lieu of Spermogonia.

L. abietina. Pycnidia, and two forms of Spermogonia.

L. flexuosa. Pycnidia.

* "Observations on New Lichens and Fungi of Otago, N. Z.," 'Trans. of Royal Society of Edinburgh,' vol. xxiv, p. 423, pl. xxx, figs. 1—7.

† Dr. Giuseppe Gibelli, of Pavia, "Sugli Org. reprod. del. Gen. *Verrucaria*" ('Mem. Soc. Sci. Nat. Ital.'), quoted in "Notulæ Lichenologicæ" of the Rev. W. A. Leighton ('Annals of Nat. History,' April, 1866, p. 270.) He asserts—though his statement is contradicted by other lichenologists (*e.g.*, by Nylander, 'Flora,' 1865, p. 579)—that in a number of *Verrucariæ*, especially those with simple spores and no distinct paraphyses,—*i.e.*, all *saxicolous* species—there are no separate spermogonia, but the upper portion of the asciferous perithecium is lined with sterigmata bearing spermatia. He calls this spermatigerous apparatus, when enclosed in an asciferous perithecium, a "Spermatokalium:" and he describes *Verrucariæ* as *hermaphrodite* where the spermatokalia constitute a fringe in the upper part of the perithecium impending over the asci, and their sporidia. On the other hand, he designates *Verrucariæ*, which have separate spermogonia and distinct paraphyses, *dicinous*. All the *saxicolous* species belong to the former category, and the *corticolous* to the latter. A very convenient generalisation, *if it be founded in fact!*

V. Genus *Lecanora :*

L. varia, especially var. *aitema, L. subfusca, L. atra, L. Ehrhartiana ;* Pycnidia ; and two or more forms of Spermogonia.

L. umbrina. Pycnidia.

L. cerina. Two or more forms of Spermogonia.

Further, in the genus *Strigula,* Spermogonia, Pycnidia, and Apothecia occur together, or Pycnidia alone ; in *Graphis scripta,* Pycnidia, two or more forms ; in *Stigmatidium crassum, Trachylia tigillaris,* and *Roccella Montagnei,* two or more forms of Spermogonia ; in *Parmelia sinuosa,* and *P. saxatilis,* var. *sulcata,* Spermogonia and Pycnidia ; in *Alectoria jubata,* Pycnidia ; in *A. lata,* Spermogonia with Spermatia and Sterigmata of the character of those of *Ramalina ;* in *Scutula Wallrothii,* Pycnidia and Spermogonia ; in *Abrothallus,* Pycnidia, and Spermogonia; in *Neuropogon melaxanthus* var. *ciliatus ;* two sizes of Spermatia—full and half-sized.

Of some of these observations, the details have been already published in various memoirs in the 'Transactions' or 'Proceedings' of the Royal Society of Edinburgh, of the Linnean Society of London, or in the 'Quart. Journ. of Mic. Sci.;'* of the remainder the details will be given probably in a 'Memoir on the Spermogonia and Pycnidia of the *Lower* Lichens," now in course of preparation.

The few lichenologists, to whom these organs are familiar, describe *Pycnidia* as rare in Lichens—as occurring exceptionally only in a few cases—while *Spermogonia* are most abundant. But such a statement arises, I believe, mainly from the circumstance that Lichen-Pycnidia have not been made the subject of special research. Among the *higher* lichens they are undoubtedly, in my own experience, comparatively uncommon ; but among the *lower* lichens they are, on the contrary, comparatively abundant, sometimes nearly as much so as the Spermogonia. In those genera and species, whose secondary reproductive organs are represented by the pseudo-genus *Pyrenothea,* I have found Pycnidia to Spermo-

* 'Transactions of the Royal Society of Edinburgh,' vol. xxii, p. 101, "Spermogonia and Pycnidia of the Higher Lichens;" vol. xxiv, p. 407, "New Zealand Lichens and Fungi." 'Proceedings of the Royal Society of Edinburgh,' vol. iv, p. 174, "Spermogonia and Pycnidia of the Higher Lichens." 'Transactions of the Linnean Society,' vol. xxv, p. 493, "New Zealand Lichens." 'Journal of the Linnean Society,' vol. ix, p. 268, "Arthonia melaspermella." 'Quart. Journ. Mic. Sci.,' January, 1857, "Abrothallus."

gonia in the proportion of twenty of the former to thirty of the latter.*

In a few cases, of which I subjoin illustrations, I have met with a certain resemblance in form between the Stylospores and Sporidia. There is insufficient ground, as yet, for supposing that this is other than an accidental coincidence. But should there hereafter prove to be a morphological relation between the two, holding good through genera and groups, it would afford a certain additional probability in favour of the supposed function of the Stylospores—of the present current belief that they are *secondary spores, capable of germination.*

Illustrative examples—

Opegrapha pulicaris ; *Spores* fusiform ; 3-5-septate.
„ „ *Stylospores* ellipsoid or oblong ; frequently 3-septate.
O. atra ; *Spores* fusiform, or obovate-fusiform ; 3-septate.
„ *Stylospores* broadly ellipsoid, or oblong ; 1-septate.
Verrucaria Taylori ; *Spores* subfusiform ; 1-septate.
„ „ *Stylospores* broadly ellipsoid or oblong ; 1-septate.
V. cinereo-pruinosa ; *Spores* oblong ; constricted in middle ; 1-septate.
„ *Stylospores* oblong or ellipsoid ; sometimes figure-8 or dumb-bell-shaped.
V. chlorotica ; *Spores* oblong ; simple.
„ *Stylospores* oblong, or oblong-oval, or pyriform, or dumb-bell-shaped ; sometimes 1-septate.
Lecidea abietina ; *Spores* acicular or subfusiform ; 3-septate.
„ *Stylospores ;* ellipsoid or fusiform ; simple.

Nylander and other lichenologists apparently regard *Spermogonia as male or complementary organs* of reproduction. There are many arguments in favour of such a view ; but the function has yet to be proved. There is no reason to doubt

* Gibelli found Pycnidia in *Verrucaria carpinea*, Pers., *Sagedia carpinea*, Mass., *S. Zizyphi*, Mass., *S. callopisma*, Mass., *S. Thuretii*, Körb., *Pyrenula minuta*, Næg., *P. olivacea*, Pers., *Verrucaria gibelliana*, Gar. While Fuisting, of Berlin, met with them in *Opegropha varia*, Pers., *Acrocordia gemminata*, Mass., *A. tersa*, Körb., *Sagedia netrospora*, Hepp., *S. aenea*, Wallr. In *Acrocordia tersa* the stylospores are *simple* ; in *Opegrapha varia*, *Acrocordia gemminata*, and the majority of lichens, in which they occur, *septate.*

the physiological relation of the Spermogonia to the Apothecia or perithecia—of the Spermatia to the Sporidia—save the circumstance that no act equivalent to impregnation has yet been actually observed. If my observations and those of Gibelli, as to the discovery of Spermatia and Sporidia in the same conceptacle, should hereafter be confirmed, the fact then proved will furnish a strong argument in favour of the probability of the occurrence of some such action or function as impregnation. Meanwhile, if we *assume* the physiological relation of Spermogonia to Apothecia, lichens may be regarded, as they have been described by Bayrhoffer and other speculative writers, as *Monœcious* and *Diœcious*, according as Spermogonia occur on the same individuals with the apothecia or not. It is in the latter case especially,—where Spermogonia occur by themselves—that the most expert lichenologist and the most careful student will frequently find it next to impossible to determine to what species or genus to refer the isolated and secondary organs in question. Fortunately, the general rule is that Lichens are *monœcious;* and in the cases in which they are *diœcious*, they are more frequently so *accidentally* than normally.

There are many other forms of polymorphism in the reproductive organs or bodies of Lichens, which are of great interest to the philosophical botanist. Our knowledge thereof consists, however, of fragmentary and isolated observations, casually made in different parts of Europe. They are not more numerous, I believe, simply because Lichenology has been hitherto almost exclusively studied by mere systematists—by species-makers, who describe *phases of plant-life* as species, genera, or groups! Philosophical biographers of Lichens have been very few—physiologists, I mean—who have given themselves the time-consuming, and often fruitless, task of studying all the phases of development of even a single Lichen. Such labour I believe to be of the most recondite character; and it is, perhaps, not surprising that Lichenologists should always have preferred the infinitely more easy task of discovering and describing so-called *new* species, three-fourths, however, whereof will, probably, ultimately be shown by the philosophical Lichen-biographer to be merely *forms* or *conditions of growth*, undeserving, for the most part, separate nomenclature.

There is a most puzzling polymorphism in *Gonidic segmentation* in Lichens, and its results under varying external influences, *e. g.* temperature and moisture. The Leprarioid stage of development of Lichens—the fruit of gonidic segmentation—has, in the hands of systematists, hitherto been

described as various *genera* of *Algæ* (*e.g.* genera *Protococcus, Chlorococcus, Hæmatococcus, Coccochloris, Glœocapsa, Palmoglœa*, &c.). Kützing long ago affirmed that the *Lichen-gonidium* might be developed into an *Alga* or *Lichen*, according to the external influences to which it was exposed. I am not in a position to confirm his observations, because I have not myself watched the development of the gonidic cell under the varying conditions referred to. But I have sufficiently studied gonidic development in Lichens to admit at least the probable correctness of Kützing's view; while I have no doubt of *this* fact, that the cells which constitute a certain stage of development of certain *Algæ*, *Lichens*, and *Mosses*, and which are generally known as forms of the typical Lichen-gonidium, are *indistinguishable, if they are not identical.*

The subject is one to which I hope to give attention at some future time, by *growing the Lichen-gonidium artificially*, and watching its gradual development under different conditions of warmth and moisture, or their negatives. These experiments, I trust, will be connected with a comparative series by Chas. Jenner, F.R.S. Edinb., on certain of the so-called Unicellular *Algæ*.* Meanwhile, I may direct attention to the suggestive papers of Dr. Hicks, on the 'Gonidia of Algæ, Mosses, and Lichens,' in this Journal,† and in the 'Transactions of the Linnean Society,'‡ papers which contain some very interesting results of similar series of experiments.

Among minor forms of polymorphism may be mentioned —1, different forms of sporidia; 2, differences in the number of sporidia, *in the same apothecium* or species. For instance, quite recently Carroll records a var. *heterospora* of *Lecanora sophodes*, Ach.,§ which, he says, "is remarkable for having

* Mr. Jenner writes me (November, 1867)—"The subject is . . . . one of the most subtle in nature, and one the exposition of which is only possible by laborious and well-considered methods of *germination* . . . . There is no more interesting or important study connected with Natural History than that arising from the influence of circumstances on the development of the simpler forms of life. Early *vegetable* life, being more simple and facile of investigation than animal forms of life, renders it, in our present state of knowledge, the more valuable of the two. . . I have no doubt at all myself as to the *transmutation of species;* but the evidence that is ample to satisfy the individual worker is insufficient to establish a fact, which is at variance with principles of thought that rule the world . . . . I shall gladly join you in *experiments on germination* . . . I scarcely doubt some important results may be eliminated."

† 'Quart. Journ. Mic. Sci.,' 1860, pp. 239; 1861, p. 15, 90.

‡ Vol. xxiii, p. 567. All Dr. Hicks's papers have instructive relative coloured plates.

§ 'Seeman's Journal of Botany,' 1867, p. 338.

some Asci containing simple, round or oval spores, along with others filled with spores of the usual form, all *in the same apothecium*."* And again, Th. M. Fries describes a condition of *Lecidea* (*Rhizocarpon*) *geminatum*, Fw., in which, he says, "sporas singulas et binas in eodem apothecio observavimus."† My own records of observations during the last ten years will enable me to give many facts of a similar kind, when I have leisure to treat of the "*Variation of the Sporidium in Lichens.*"

I cannot, however, at present, further pursue the subject of polymorphism in the reproduction of Lichens. I have said enough, I think, to show what I mean by the term, and in what directions the subject may be studied with advantage. I trust that some of the increasing number of students of Lichenology throughout Europe will give attention to the *Biology* or Physiology of Lichens, rather than to the mere effort at the multiplication of *species* and the devising of new *names*, to the greater confusion of an already alarmingly confused synonymy. I have no wish to depreciate the labours of systematists, of species-describers, of Lichenographers so-called, provided they possess the necessary qualifications for the determination and description of species, and for classification—qualifications that should, however, confine such authors to a mere fraction of those that at present are incessantly adding to the already too bulky "Literature of Lichenology." But my experience has led me, under present circumstances at least, to esteem more highly the botanist who studies Lichen-life in all its phases, over wide areas, and in all the external conditions to which such life is exposed in Nature. Studies of such a character, besides correcting, or contributing to, our knowledge of the physiology of the Lichens (the nature, for instance, of the various processes of reproduction, of which we have as yet little *positive* information), cannot fail to generate liberal and philosophical views of the range of variation and the artificial or book-limits of species, and so to lead to the reduction and rearrangement—on a simplified plan—of the present unnecessarily and mischievously great redundancy of *species* and *genera*.

Quite recently two Russian observers‡ have discovered *Zoospores* as one of the phases or forms of development of

* The var. *octospora*, Nyl., of *Lecanora vitellina*, Ach., differs from the type in containing eight, instead of twenty or thirty sporidia.

† "Lichenes Spitsbergenses," p. 45, 'Kongl. Svenska Vetenshaps-Akademiens Handlingar,' 1867.

‡ "Beitrag zur Entwickelungsgeschichte der Gonidien und *Zoosperen*-bildung bei *Physcia parietina*, D. N."; by Famintzin and Baranietzky, 'Botanische Zeitung,' 1867, p. 189.

the gonidia of the common *Physcia parietina*, L.; and, as in the case of Kützing's results, though I have had no opportunity of confirming the observation, I have no reason to disbelieve its correctness. On the contrary, we are on the eve, I believe, of important discoveries, calculated to increase materially the number of links in that chain, which connects the Lichens with the higher and lower Cryptogamia, and even with the Phænogamia.*

Remarks *on some of the* New Species *of* Diatomaceæ *recently published by the* Rev. E. O'Meara. By Frederic Kitton, Norwich.

Having studied the Diatomaceæ for many years, I am convinced that a large proportion of the new genera and species obtained from dredgings or deposits have no claim to that distinction; no satisfactory generic or specific characters can be deduced from form procured from such sources. It is also a great error to suppose that the locality from whence a dredging is obtained is the habitat of the forms found in it. In the majority of instances the valves only are found, perhaps only one, perhaps only a fragment. The fact that only one valve or frustule is found, is of itself sufficient evidence that we do not know its habitat (it may be a few yards off or a thousand miles away). The living diatom multiplies with great rapidity; if we found its true habitat, it would occur in myriads and not as a rare or unique specimen.

The forms found in dredgings, &c., have probably been deposited by the decay of animal and vegetable matter, as Noctilucæ, Ascidians, mollusks, seaweed, &c., and brought there by ocean currents from far distant localities; or it may even happen that they have been washed out of some diatomaceous deposit by river action, and carried forward to the ocean, and at last deposited amongst the *dèbris* of recent species. I have been induced to make these remarks by the publication of two papers ('Mic. Jour.,' Vol. VII, N. S.), by the Rev. E. O'Meara, on "New Species of Diatomaceæ pro-

* The character of their cellular tissue, of their chemical constitution, of their contained raphidian or other crystals, of their spiral vessels (recently observed in *Evernia prunastri*, L., byA dmiral Jones, 'Dublin Quarterly Journal of Science,' Jan., 1865, p. 91) form strong points of resemblance to flowering plants.

cured from Dredgings." In the following observations I have assumed the amplification in the first paper to be the same as that in the second, viz., 600 diameters.

The following forms, described in the Rev. E. O'Meara's papers (Vol. VII.), may, I think, be referred to previously described species.

Navicula pellucida, O'M., fig. 2, is a state of *N. Pandura* of De Brèbisson.

Navicula Wrightii, O'M., fig. 4. is certainly only *N. clavata* of W. Gregory; the striæ next the median line being obliterated by abrasion.

Navicula amphoroides, O'M., fig. 3, seems to be an Amphora resembling *A. salina* of the Synopsis (= *A. proteus* of W. Gregory). Query, is not the nodule a small grain of quartz?

Pinnularia constricta, O'M., fig. 8, possibly a form of *Navicula truncata*, a very variable species both in size and costæ.

Pinnularia divaricata, O'M., fig. 7, if correctly figured and described, can be neither a Pinnularia nor Navicula, as none of these genera have forked striæ or costæ.

Surirella pulchella and *gracilis*,* O'M., figs. 10 and 11, are only forms of *S. lata* of the Synopsis, and this is merely a variety of that most variable form *S. fastuosa*. In a good gathering of this species, *S. pulchella*, *S. gracilis*, *S. lata*, may all be detected, and probably a dozen other species if slight differences in size, outline, or striation, constitute new species. Dr. Greville, in 'Trans. of Mic. Soc.,' 1862, p. 19, makes the only difference between *S. lata* and *S. fastuosa* to consist in the form of the median space; but an examination of numerous specimens proves that his *only* character is of no value, for in specimens from the same locality all forms of the median space appear. Dr. Gregory proposed uniting his *Campylodiscus simulans* with *S. fastuosa*, but the former is a true Campylodiscus having the poles of the opposite valves at right angles to each other (a feature not peculiar to *C. simulans* or *C. bicruciatus*, in the Campylodisci the opposite valves of the frustule are always in that position). *C. bicruciatus* is only a frustule of *C. simulans*, and the latter is only a large variety of *C. parvulus*.

Coscinodiscus fasciculatus, O'M., fig. 1, Vol VII, is an

* Herr Grunow describes and figures a *S. gracilis*. The following are his specific characters:—"*S. gracilis* in (= *Tryblionella gracilis*, W. Smith? ?) Mittelgross, Schalen breit linear mit abgerundeten oder conischen Enden, Rippen 12—14 im 0·001 Im süsswasser." 'Verhand. der k.k. zoo.-bot. Gesellschaft in Wien,' Band 12, s. 450, u. , Taf. vii, fig. 11.

injured valve *Actinocyclus* (*Eupodiscus*, Smith) *Ralfsi* (*var. E. sparsus* of Gregory), that portion of the valve upon which the pseudo nodule occurs was, I suspect, broken off, as the author says it was an imperfect specimen, or it may have been overlooked as it is sometimes very minute. This is commonly the case with the *Coscinodiscus Barklyi* of the Yarra Yarra deposit and which is, I believe, identical with *C. fuscus;* both are species of Actinocyclus (the presence of a pseudo nodule is not recognised by Ehrenberg).

Stauroneis costata, O'M, fig. is, I think, a sporangial state of *Achnanthidium lineare.*

The valves of Cocconeis, like those of Arachnoidiscus, Actinoptychus, and some other genera, are composed of two (generally) dissimilar plates; the upper valve (both plates) and the lower plate of the lower valve have neither median line nor nodule, while the upper plate of the lower valve has both, and when the two valves are united, we see the median line and central nodule of the lower through the upper valve and imagine it belongs to the upper. All figures hitherto published are imperfect in so far as they do not give—1st, both valves in conjunction, 2nd, upper plate of the upper valve, 3rd, lower plate of ditto, 4th, lower valve, 5th, upper plate of ditto, 6th, lower plate of ditto. Occasionally two or three species present precisely the same appearance in the lower plate of each valve, and the chief characters are therefore to be got from the upper plates of the two valves. But we cannot contrast any figure of the two valves with either an upper or lower valve separated, nor one of these with the other. It will thus be evident that any description of new species from a single specimen or even series of specimens procured from deposits or dredgings must be erroneous.

Cocconeis Portii, O'M, fig. 7, Vol. VII, N. S., shows both valves in conjunction and appears to be a small state of *C. scutellum.*

Raphoneis liburnica, O'M, fig. 8, is the upper valve of a Cocconeis, but of what species I am not able to say; it may probably be *C. distans*, W. Gregory.

R. suborbicularis, O'M, fig. 9, is one of the plates of the upper valve of *Cocconeis Grevillii.*

R. Jonesii and *R. Moorii*, O'M, figs. 10 and 11, are both the upper valves of one and the same species of Cocconeis, perhaps *C. scutellum.* The absence of the hyaline margin in fig. 10 is of no specific value, it has possibly become detached, an accident of frequent occurrence; *Cyclotella rotula* and

C. antiqua are frequently found with the marginal band detached.

R. Archerii, O'M, fig. 12, is the upper valve of a Cocconeis with the puncta abraded, probably it is *C. costata* of W. Gregory (*Cocconeis divergens*, fig. 5, may be the same but the lower valve).

Eupodiscus excentricus, O'M, fig. 2, seems to be a valve of *Coscinodiscus minor* of Kützing, with an abnormal marginal development similar to a state of *Amphitetras antediluviana*, fig. by Mr. Brightwell, in Vol. VIII of the 'Mic. Journ.'

In conclusion, I will venture to observe that the publication of isolated and imperfect specimens not only do not advance our knowledge, but, on the contrary, are an hindrance to the study of these minute forms, and it would be far better to keep all such in an obscure corner of the cabinet or throw them into the fire, than publish them with crude and imperfect characters. A far greater service would be rendered to the study of minute forms of organic life, if the extent of variation in one single species was made the subject of examination than the publishing a score of RARE SPECIES.

DESCRIPTION *of a New Genus of* DIATOMACEÆ, *and observations on the costæ of* PINNULARIA PEREGRINA. By FREDERIC KITTON, Norwich.

A VALUED correspondent has informed me that the form described in the Synopsis as Gomphonema Fibula is not a Gomphonema, but must be considered a new genus.

PERONIA, N. G., Brèbisson and Arnott. Frustules solitary, elongated, linear, and slightly cuneate, attached by the base. Valves attenuated but obtuse at the base. Constricted and subcapitate at the apex, destitute of nodule, and median line, striæ transverse pervious (across the whole valve). *P. erinacea*, Brèb. and Arn.; *Gomphonema tibula*, Brèb. MS.; *G. Fibula*, Kützing, Smith; *Synedra spinulæformis*, Sm. MSS. *Syn. Fibula*, Smith, in Brit. Mus. Cat., p. 33. Fibula being more a clasp than the tongue or pin of the clasp, is scarcely so good a name for the genus as the Greek one Peronia, but, at the same time, is too closely allied to permit it to be used for the specific name. This diatom covers the leaves of Sphagnum, and the margin of the decaying leaves of grasses like pins in a pincushion.

Pinnularia peregrina.—Whilst examining the valves of this form with a high power (800 diameters), I accidentally discovered that the costæ are transversely striate on their internal surface. The striæ are about 50 in ·001 of an inch. I have not been able to detect this peculiarity in any other species, nor has it been noticed in any work with which I am acquainted. Dr. Gregory, in 'Mic. Journ.,' Vol. III, Trans., p. 15, says, "I may mention that a friend informs me that the striæ on *P. gracilis* have been found by him to be moniliform, although the fact may not yet be thoroughly established. *This, it will be observed, corresponds with Mr. Smith's observation on the striæ of P. peregrina.*" But where does Smith say so?

I may mention that oblique light at right angles to the valve is necessary to bring out the striæ.

TRANSLATION.

Iagttagelser anstillede i Löbet af Vinteren, 1863-64, *som have ledet til Opdagelsen af de hidtil ukjendte* Befrugtningsorganer *hos* Bladsvampene. Af Prof. A. S. Oersted. (*Observations made in the course of the Winter of* 1863-64, *which have led to the discovery of the hitherto unknown Organs of* Fructification *in the* Agaricini. By Prof. A. S. Oersted.)

('Oversigt over det Kongelige danske Videnskabernes Selskabs Forhandlinger." Copenhagen, 1865, p. 11, pls. i, ii.)

1.

Although, within the last decade, organs of fructification have been demonstrated in so many of the lowest cryptogams, that we are justified in assuming that a distinction of sex pervades the whole plant-world, as well as that, as regards the maintenance of the species, fructification is of the same import for the spore-bearing as for the flowering plants—nevertheless, there are whole great groups, especially in the class of Fungi, in which organs of fertilisation are still quite unknown. Thus, this applies to the Agaricini (Bladsvampe), which, as well as by their complex structure, their richness in forms, and their size, take the highest place in the system of Fungi. Gleditsch and Bulliard, certainly, have already attributed the same import as that of the stamens of flowering plants to the cylindrical or clavate cells, discovered by Micheli in 1729, and designated as "filamenta" or "stemones," which so frequently occur amongst the basidia in Agarics;* and so also afterwards Léveillé, who brought the name "Cystidia" for these organs into use, and especially Corda,† who called them "Pollinaria," and compared them with the pollen-grains in the flowering plants, and likewise

* 'Der Befruchtungsprocess im Pflanzenreiche,' von L. Radlkofer, p. 2.

† "Ueber Micheli's Antheren der Fleischpilze," 'Flora (Regensburg),' 1834, i, p. 113. 'Icones Fungor,' tom. iii, p. 44.

also Klotsch,* who sought to maintain the import of these organs as that of male organs of fructification; but, after Hoffmann's researches, it must be regarded as settled that the pollinaria are only a sterile form of basidia.† If now we add to this that Tulasne has shown that the organs designated spermatia by Hoffmann cannot be accepted as organs of fertilisation, but that they correspond rather to the conidia (microconidia) in other Fungi,‡ whereby likewise Karsten's observations§ lose their significance, we thus arrive at the result that no one has hitherto succeeded in demonstrating organs in the Agaricini, to which, in the present state of knowledge of the lower plants, there could be attributed the import of organs of fertilisation.

2.

The consideration of the Agaricini, viewed morphologically, leads to the conviction that the whole spore-receptacle (Sporchus) must be a result of fertilisation, and that thus the organs of fertilisation must have their seat in the mycelium, and for several years I have had my attention directed to this organ.

Experiments in culture were undertaken in order to follow out the development from the germinating spore to the formation of the receptacle, but they did not lead to any successful result, for the mycelium always died away shortly after germination. I had only then to go back to Nature to seek out the first stages of development of the receptacles in order to be guided through these to the organs of fertilisation; but the difficulty here presents itself that the mycelium is always underground, and does not admit of being easily brought under the microscope in such a condition that one can get a clear view of the individual filaments. At last I succeeded in getting a clue to an agaric, which, contrary to the habit of Fungi, spreads its mycelium above ground.

This is *Agaricus* (*Crepidotus*) *variabilis*, Pers., which, for our present research, presents that very favorable condition; one of the earliest known Fungi, which has been many times described and figured, but one whose development-history has been hitherto the same thing as unknown.‖ It was in the

* In Dietrich's 'Flora des Königreichs Preussen,' Bd. vi.

† 'Botanische Zeitung,' 1856, p. 135.

‡ 'Selecta Fungorum Carpologia,' Tom. i, p. 161. In the 9th chapter of this classic work is given a complete review of the whole of the literature treating on the fructification of Fungi.

§ 'Bonplandia,' 1861, p. 63.

‖ E. Fries, 'Systema mycol.,' i, p. 275; 'Epicrisis,' p. 211. "Crepi-

mushroom-bed in " Rosenborg " garden that this Fungus had flourished. In the bed prepared for mushrooms it spread its mycelium like a delicate cobweb over the earth, and in the same spot one could find receptacles of all sizes. It was thus easy, by arranging the different stages of development in a descending sequence, to form a series of steps which gradually led from the fully-grown spore-receptacle down to its first rudiments, hardly perceptible as a white point. Under a slight magnifying power this shows itself as a conical felted body. This form is retained by the receptacle until it has attained a size of 1–2mm. The first rudiments of the pileus begin now to be evident as a little globular expansion at the point of the conical stem. At the beginning the pileus grows uniformly at all sides, and the receptacle is therefore at this stage regularly formed, as in Agarics in general.* The expanded base of the stem passes quite gradually over into the mycelium-filaments, which radiate towards all sides, so that here the organ designated as a root by the older mycologists is wanting.† Only when the receptacle has attained the size of 4–8mm. does the pileus begin to grow more strongly at one side, and thus by degrees the horizontal position is exchanged for the vertical. Since the stem, when the pileus is first commenced, ceases altogether to grow, the fully-grown receptacle is very short-stemmed. The pileus is undulate, wavy at the margin, bulged or lobed, membranous or half-pellucid. The receptacle is often compound and formed of two receptacles growing together by the stems, or of three or more united by their bases.

For so far the observation of the development of the receptacle offers no difficulties. These begin only when, by the aid of the microscope, we would seek to account for the relations of the earliest developmental stages to the organs of fertilisation, and it was only after many unsuccessful trials that I succeeded in making preparations which would serve to give a distinct conception of these organs. The mycelium-

dotus, by reason of its short-stalked or stalkless eccentrically attached pileus, forms a subgenus amongst the brown-spored Agarici, analogous to Pleurotus amongst the white-spored. Both subgenera likewise have this in common, that they, almost without exception, include species which grow on trees. The above-named species has been already described in 1690 as *Fungus albus minimus trilobatus* (Ray, 'Synops. method. stirp. brit.'). It is figured (amongst other places) in Persoon's 'Observationes mycologicæ,' ii, t. v, f. 12, and twice in 'Flora Danica,' viz., t. 1073 (as *Agaricus pubescens*, Vahl), and t. 1586.

* This condition has not escaped Persoon's attention ('Observ. myc.,' ii, p. 46).

† The present species is thus described by E. Fries, "radiculis nullis" ('Syst. myc.,' i, p. 275).

filaments have, indeed, so thin, soft, and gelatinous a membrane, that, when one tries to loose them from the soil, they become, at the slightest contact, confluent into a mucous mass, or a mucous net, with larger or smaller openings. Little better success attends placing some of the soil overgrown by the mycelium under the microscope, for one is not able to apply a sufficiently high magnifying power. However, one can, even by this plan, satisfy oneself of the existence of two organs on the mycelium which cannot be seen by the unassisted eye. There thus present themselves numerous short filaments, which arise up vertically, and bear at their point a globular cell. These filaments are thinner towards the points, and appear to consist of three cells, of which the lowest is only a little longer than broad, the next about twice as long, and the uppermost much longer. Besides these filaments one can discern another organ, much smaller, appearing only just a little above the mycelium-filaments; but it is seen so indistinctly that one is not at all able to form a conception of its structure. I tried, therefore, placing thin glass plates over the soil, in order to get the mycelium to become spread thereon. This succeeded so far that one could get a very clear view of the growth and ramification of the mycelium. The mycelium grows very quickly, and in the space of a few hours the glass plate, 10mm. long and 6mm. broad, became quite covered over by the delicate filaments, which adhere as closely to the glass as if they were attached with gum. Since the filaments hardly alter their form in drying, these glass plates may be preserved without any further preparation as instructive specimens of the mycelium. The mycelium so formed remained, however, sterile, and I was almost about to give up hope of a successful result, when I hit upon the idea that the mycelium spread upon the soil would, perhaps, after being dried, more readily admit of being separated and brought under the microscope in such a condition that one could get a clear view of the organs seated thereon. This proved itself indeed to be the case, since the soft and mucous mycelium-filaments are prevented by drying from falling together, and can be separated by a fine needle into minute portions, which are quite free from particles of earth, and thus can be examined under the microscope, with the highest magnifying powers. The mycelium is now softened, first with alcohol—when this precaution is not observed, the view is made very indistinct by the quantity of air-bubbles—and, after a drop of water is added, the individual filaments and the organs seated thereon quickly assume the same nature which they had previous to being dried.

It was only by preparations made in this way that I succeeded in getting a clear view of the mycelium-filaments, and of the organs seated thereon, of which I had previously only got an indistinct glimpse, as well as arriving at a knowledge of the organs of fertilisation so long in vain sought after in these fungi.

3.

The mycelium consists of very long, tubular, and branched cells, $\frac{1}{300} = \frac{1}{100}$ mm. in diameter, and loosely felted amongst one another. These cells are very regularly dichotomously branched, which is especially distinctly seen when the mycelium is formed, as above mentioned, upon little glass plates, as the mycelium then forms only a single layer.

The principal stem divides into two branches; these divide again in the same manner; and this branching is repeated to the extreme points. The cell-membrane is extraordinarily thin and soft and mucous—it has almost the character of a mucous membrane—so that the cell-filaments readily become confluent, a condition which has a peculiar interest in that it shows the relationship of these mycelium filaments with the plasmodium of the Myxogastres (Slimsvampe);* the cell-contents, when slightly magnified, appear as a light-yellow mucus; but with a higher magnifying power they are seen to be almost exclusively formed of greyish, partly very minute, partly larger granules, amongst which occur minute yellow globules (oil-drops?); the larger granules are often surrounded by a clear mucous investment, and sometimes there occur large, almost clear, slightly reddish, mucous masses.

Of the organs which present themselves upon the mycelium, should be first mentioned the bud-cells (Knopceller), or the above mentioned three-celled filaments, with a globular cell at the apex. These now present themselves under so different an appearance, that one cannot readily believe them to be the same organs which were previously before one. The septa have quite disappeared from the stems, and, instead of the globular cell, have come a considerable number of very minute cells. That the above described form, that under which these organs present themselves when seen in air, depends upon an optical illusion produced by the drawing together of the cell-contents and cell-membrane, we can readily satisfy ourselves by observing the gradual transforma-

* Compare, thus, the mucous net formed by the union of the mycelium filaments (tab. i, fig. 10) with the plasmodium of *Didymium leucopus* (Pringsheim's 'Jahrbücher für wissench. Botanik,' 3 Bd., 1863. tab. xviii, fig. 7).

tion which takes place when the alcohol, and afterwards the water, is brought in beneath the covering-glass, under which the dry mycelium is placed. One sees then that these organs, by degrees, expand to more than double their dimensions, whilst at the same time they are changed, so that the septa disappear, and the (seemingly) single terminal cell gradually breaks up into a number of smaller cells. The stem-cell is often slightly narrowed at the base, and it is not separated by any septum from the mycelium cells, whence it proceeds, and has the same contents as it. The cells united into a globular head at the end of the stem vary much in size and number; sometimes they are larger, and then fewer in number; sometimes smaller, and then much more numerous. They easily fall off, and then it is seen that they are oval, and that they present themselves as round only when seen from the ends; they have hyaline contents, and only seldom is there seen a nucleus-like body. As regards the development of these organs, there appears to be formed first a cell at the end of the stem-cell; when this has reached a size of about $\frac{1}{30}$ mm., and while the stem grows in length to about $\frac{1}{10}$ mm., the end cells gradually increase in number. These organs cannot be regarded as serving fertilisation, but correspond quite to the conidia or bud-cells, which of late years we have learned to know in many fungi, and especially in many Sphæriæ,* whilst under this form they have not hitherto been known in agarics. But if they have not been known as conidia, yet have they been not quite unknown; of this we may satisfy ourselves by comparing with Corda's figure of *Cephalosporium macrocarpum*.† There cannot, indeed, be any doubt but that both figures refer to the same plant; and we arrive thus at the result *that the species included under the genus Cephalosporium are not independent fungi, but the mycelium of Agarics forming bud-cells.*

From the same mycelium-filaments which bear the bud-cells, or from others, proceed likewise the organs of fructification. The female organ of fructification occurs, as in most of the lowest spore-bearing plants, as a single cell—the oogonium. The first rudiments of this cell present themselves as an eversion, which from the beginning is curved down towards the mycelium filament, and, by degrees, as the oogonium grows, it becomes almost reniform, becoming appressed, its apex lying against the side of the mycelium filament. Such oogonia originate in numbers from the mycelium filaments, and have always essentially the same

* Tulasne, 'Selecta Fungorum Carpologia,' tom. 2.

† 'Icon. Fung.,' iii, tab. ii, fig. 30.

form, the same size, and the same position.* They have a length of $\frac{1}{50}$ mm., and are about $\frac{1}{100}$ mm. in diameter; and they seem to be separated by a septum from the filaments whence they proceed. The contents are mostly but little different from those of the mycelium, only the granules are larger; and especially there are found here many of the yellow or yellow-brown globular bodies, which, besides, are very large. However, there are often seen in the oogonia a quite clear, hollow space (vacuole) of varied form, and taking up about the one half of the cavity of the cell. In the hollow space is observed a nucleus-like body, or in its place are seen several yellow-brown globules. In one oogonium was found, in place of the hollow space, a clear, yellow mucus; and here the yellow-brown globules lay between this and the cell-membrane.

From the base of the oogonium there proceeds at each side a filiform antheridium-cell, which is very thin (only $\frac{1}{500}$–$\frac{1}{400}$mm. in diameter), two or three times as long as the oogonium, and usually gradually diminishing in thickness towards the point; sometimes the antheridial cells are furcately branched; or only one of them is normally developed, whilst the other is either altogether wanting or is very short. The contents are usually quite pellucid, more rarely a few granules are present, but antherozoids are not found here any more than in most other Fungi. As regards the relation of the antheridial cells to the oogonia, they are usually seen hanging freely at the side without coming in contact with the latter. Only twice were the antheridial cells seen in such a union with the oogonia as is accustomed to take place during fertilisation. In one of the cases it was the antheridial cells belonging to the oogonium, in another case it was an antheridial cell from another oogonium which presented itself in this union.

Amongst many antheridial cells an altogether peculiar condition was observed but once, and there can hardly be attributed to it therefore any special significance. This consisted in the fact that three adjacent antheridial cells, placed about the usual distance from one another, were mutually united.

Notwithstanding that thus we have only imperfect observations with regard to the act of fertilisation itself, it yet does not admit of the slightest doubt but that the organs just described actually have the significancy which has been here attributed to them, since they agree so exactly with the organs of fertilisation in other Fungi (for instance, in

* Once were seen two oogonia proceeding from the same place.

Peronospora and Saprolegnia); in the flowering plants, indeed, fertilisation has been observed in only a comparatively small number of species, and yet it will not be doubted that this takes place in all plants furnished with stamens and pistils.

If, then, we come to inquire as to the operation of the fertilisation, and as to the relation of the organs of fertilisation to the receptacle, I have not yet succeeded in obtaining so clear a view of this stage of development as to be able to repeat it by a figure; but, after what I have seen, it must be assumed that the operation of the fertilisation consists in there being thereby called forth a peculiar growth of the mycelium filaments bearing the oogonia, so that there becomes produced a dense tissue proceeding from them, including several oogonia, which, when it has attained a certain size, presents itself as a little white felted spot, hardly evident to the naked eye—the above-mentioned first rudiments of the receptacle. The oogonia after fertilisation do not appear to undergo any further transformation; only once was seen a beaklike elongation of the anterior part of the oogonium. The fertilisation thus appears to stand in the same relation to the formation of the receptacle as that which (resulting from de Bary's researches) must be assumed to take place in Peziza.*

To sum up, in conclusion, the results to which the foregoing observations in the development of *Agaricus variabilis* have led, are as follow:

1. The mycelium of this Fungus is formed of long dichotomously branched tubular cells, without septa, united into a loose web, and with so thin and soft a membrane that it has almost quite the character of a mucous membrane.

2. From the mycelium cells proceed both vegetative organs of propagation or bud-cells and organs of fructification.

3. The organs formed as bud-cells have been previously described as and independent species amongst Hyphomycetes (*Cephalosporium macrocarpum*).

4. The female organ of fructification is a reniform oogonium, which is curved down against the mycelium-filament, whence it originates, with its apex pressed towards it. The male organ of fructification consists of two filiform antheridial cells proceeding from the base of the oogonium.

5. After fertilisation several oogonia in union give rise to the formation of a receptacle. The oogonia are included in

* 'Ueber die Fruchtentwickelung der Ascomyceten,' von Dr. A. de Bary, 1863.

the dense filamentous tissue which forms the first rudiments of the receptacle, without (as it appears) their undergoing any transformation.

6. The stem is that part of the receptacle which is first produced, afterwards the pileus. This is at first regular, horizontal, and attached to the stem by the middle of the under surface, afterwards it becomes oblique, vertical, and attached to the stem in the neighbourhood of the margin.

QUARTERLY CHRONICLE OF MICROSCOPICAL SCIENCE.

Archiv fur Mikroskopische Anatomie. Bd. III, heft iii. *Supplementary Notice.*

Our Chronicle was necessarily curtailed considerably last quarter, hence we here give more extended notices of some of the Papers in this part of the 'Archiv.'

1. "*On the Genesis of the Seminal Corpuscles,*" by La Valette St. George.

Referring to a paper published in 1865, in the 'Archiv,' by Schweigger-Seidel, the writer remarks that that author states that the substance of which the spermatic corpuscles are composed is by no means of uniform nature throughout, but always presents peculiar characters at various parts. These apparently simple corpuscles, consequently, are composed of segments distinctly differing in form and chemical constitution. For instance, in the mammalia the upper part of the filament is distinguished from the remainder by its large and more uniform thickness, greater brilliancy, and different behaviour under various chemical reagents. Neither does it take any part in the movements of the filament. In birds and amphibia it is also characterised by certain differences. Schweigger-Seidel, therefore, regards it as a special segment or "intermediate-piece," interposed between the head and tail. M. Valette St. George, however, states that in some instances in human spermatozoa he has noticed this intermediate-piece, which it is sometimes difficult to discern, to take part, though faintly, in the motion.

In those of the Hedgehog, taken from the *epididymis*, this "intermediate-piece" was usually very readily discernible, though sometimes not so well defined. M. St. George states that the *testis* of this animal is peculiarly well adapted for the study of the development of the spermatozoon, owing to the greater transparency of the contents of the sperm-cells. In the Guinea-pig, Rabbit, and Dog, a similar constitution of the corpuscles can be readily perceived.

With respect to the development of the spermatic bodies, nearly all that is essential has been already communicated by Schweigger-Seidel in the paper above cited; and like that observer, M. Valette St. George has been able to trace the transformation of the nucleus of the sperm-cell into the rod-shaped head, as well as the formation of the filament from the cell-contents. The process may be well seen, he says, in the Spotted Salamander. The nucleus becomes elongated and transformed into the head of the spermatozoon, being frequently rolled up in the cell. Its outermost part forms a distinctly defined appendage, 0·008mm. long.

The author proceeds to compare the result of his researches on the development of the spermatozoon in the Vertebrata with those of other observers—as Kölliker, Ankermann, Pflüger, and Henle, who, though agreeing with Kölliker that the head of the spermatozoon is a metamorphosed nucleus, conceives, nevertheless, that for the formation of the tail a persistent connection of the head with the cell is indispensable. He also notices the views of Grohe, who considers the nucleus of the sperm-cell as merely a particle of contractile substance, which he thinks it probable is developed spontaneously from the cell-contents.* According to Schweigger-Seidel the spermatozoon is not a simple nuclear formation, but corresponds, as a transformed one-rayed ciliate cell, to an entire cell. Of the two kinds of cells found in the tubuli seminiferi, only one kind with minute clear nuclei undergoes the transformation into spermatozoa.

The author's own views, as above stated, appear to coincide pretty nearly with those of Schweigger-Seidel, viz., that the nucleus and the cell-contents are both engaged in the formation of the spermatozoon. In the mammalia the first change consists in the nucleus becoming more transparent, and losing its granular contents, or exhibiting instead a round nucleolus, which in its turn disappears. One half of the nucleus then exhibits a thickened contour as well as an appendage in the form of a nodule, which may become developed into a sort of cap. At the same time it becomes elongated, and assumes a brilliant aspect, and now, or a little before this, a filament sprouts out of the cell which comes into connection with the nucleus. The cell substance disappears by degrees, and ultimately becomes attached as a smaller or larger appendage to that part of the filament designated by Schweigger-Seidel the "intermediate-piece."

Some observations, but not of much importance, on the

* "Ueber die Bewegung der Samenkörper." Von F. Grohe. Virchow's 'Archiv,' xxxii.

development of the spermatozoa in certain insects and snails, conclude the paper, which is illustrated by numerous figures.

2. "*On the Structure and Development of the Labyrinthuleæ*," by Professor L. Cienkowski.

In the last Chronicle a brief notice of this paper was given, and the author's summary of his conclusions (vol. vii, p. 277).

The organisms in question were found in the harbour of Odessa by Professor Cienkowski. His observations have led him to recognise provisionally in them a new group, for which he proposes the name of Labyrinthuleæ.

The members of this family are of microscopic dimensions. They form thin, reticulate, colourless filaments, on which fusiform bodies circulate very slowly in various directions. The meshes of the net exhibit extreme differences in size and shape. Another characteristic of these organisms consists in the presence in various parts of imbedded globular or fusiform masses, from and into which the filaments appear to arise and to be inserted. The reticular arrangement is often wholly absent, when the filaments are disposed in an arborescent manner.

The network, as well as the arborescent ramifications, spring from a central mass, which is sometimes as big as a pin's head. And in these globular or irregularly formed aggregations the Labyrinthuleæ are met with on fragments of wood encrusted with algæ, when they have been allowed to remain in water for several days.

The author has been able at present to make out only two specifically distinct forms, in one of which the fusiform particles are of a yellow colour, and in the other colourless. Including both in one genus, *Labyrinthula*, he names one *L. vitellina* and the other *L. macrocystis*.

In *L. vitellina* the central mass consists of an aggregation of globules 0·012mm. in diameter and having a very delicate contour, and whose contents seem to derive their colour from a reddish or bright yellow pigment. The entire mass is held together by a delicate, finely-granular, cortical substance, which often forms at the periphery a thin enveloping layer. On the addition of alcohol this layer appears in the form of a delicate membrane at some distance from the shrunken globules. The material of which it is composed is not coloured either blue or brown by iodine. It is dissolved in concentrated sulphuric acid, but the author has been unable to perceive any proof of its containing cellulose.

Besides the large central mass, there are observed in various parts of the net smaller aggregations of globules,

which, however, are not surrounded by any cortical substance. From the central mass, as well as from these smaller masses, spring in all directions the colourless, usually very fine, but sometimes coarser, anastomosing threads in which the coloured fusiform corpuscles, either simply or several together, pursue their lazy course.

Observation shows that by degrees all the globules in the central and other aggregations assume the fusiform shape, and proceed along the filaments until, at the end of several hours, the greater part of them may be observed to have reached the edge of the fluid in which the specimen was immersed.

The fusiform corpuscles vary greatly both in size and shape; the latter varying from perfectly globular to that of a thread slightly thickened in the middle. They seem to consist of a homogeneous protoplasmic substance. They are never seen to coalesce. When closely examined the body is seen to be flattened, and without any visible membranous envelope; it represents a mucus-corpuscle, with scattered granules and pigmentary particles. In the centre is a *nucleus*, which appears like a clear vacuole, containing a strongly refractive *nucleolus*. The colouring matter in its chemical reactions seems to resemble the red spots in *Euglena*, the *Rotifera*, *Uredineæ*, &c.

The motion of the fusiform particles, which, from the description, would appear to bear some analogy with that of the granules in *Tradescantia*, &c., is excessively slow, not exceeding, according to the author's observations, $\frac{1}{40}$th to $\frac{1}{80}$th of a millimetre in a minute, nor is it very uniform. The principal direction seems to be towards the periphery of the drop of water, but the shortest road is not invariably selected, so that sometimes, missing the way, they return to the central mass from which they had started. With respect to the cause of the motion the author has been unable to make out anything satisfactory. It appears certain, however, that whatever it is, it resides in the corpuscle, and not in the filament, although the former is unable to move, except when in connexion with the latter.

With regard to the nature and properties of the filaments and the substance of which they are composed, it is remarked that they are solid, and the substance non-contractile; consequently, they in no way resemble the pseudopodia of the Rhizopoda.

The author enters into a long discussion regarding the mode of origin of the threads and their component fibrillæ, and the result at which he has arrived is, that the ultimate

fibrils of which the thicker filaments are composed are all produced from the fusiform corpuscles. The whole network, in fact, may be described as a gelatinous, fibrillated secretion of the corpuscles.

The second species, *L. macrocystis*, agrees with the former in all essential particulars of structure, &c. Its corpuscles, however, are somewhat larger (0·018—0·025 mm.) and of denser consistence; the *nucleus* is better defined, and the contents more granular and colourless, or with the faintest yellow tinge. The cells constituting the central mass have in this species usually an arched or curved form, with rounded ends, and the convexity directed towards the periphery of the mass. When viewed with a pocket lens, the masses appear as white or yellowish gelatinous drops, which are sometimes aggregated into vermiform growths which are seen, several together, on various parts of the algan incrustation.

In further illustration of the nature of the Labyrinthuleæ, the author states that the fusiform corpuscles multiply by division, the first indication of which is the formation of a septum, usually running obliquely across the cell in the line of its future scission. In this process the *nucleus* does not divide, but a new *nucleus* is formed in one of the segments.

Under certain circumstances, as, for instance, when exposed to partial desiccation, *L. macrocystis* has the power of very readily becoming quiescent, that is to say, of becoming encysted, in which condition it may remain for many weeks unchanged.

3. "*On Clathrulina, a New Actinophryan Genus*," by Professor L. Cienkowski. The growths to which the name of *Clathrulina* has been applied, and of which it would seem Professor Cienkowski has distinguished two species, or rather varieties, consist of protoplasmic masses, lodged free within a fenestrated shell, through the wide openings of which the numerous pointed pseudopodia project, and which is supported on a long, rigid peduncle, by which it is affixed to various subaqueous objects. The shell or case also not unfrequently itself forms the basis of support of the peduncles of other *Clathrulinæ* disposed in a radial manner, and again serving for the support of a second series, and so on.

It was in this aggregated form that the author first discovered the genus about ten years since in St. Petersburg, in a tank containing *Nitella*, *Vaucheria*, &c.; and he has since observed it in Dresden, Franzensbad, but very rarely, and in small quantity. The growth may be simply described as an *Actinophrys* contained in a fenestrated case of a globular or

pyriform shape, about 0·072 mm. in diameter, and whose wall is composed of polygonal, firmly connected convex rings, or perforated plates. Its surface consequently presents numerous depressions. The *fenestræ* are of various sizes and forms; most have a rounded or polygonal, more or less regular outline, but the smallest are large enough to admit conveniently *Chlamydomonadæ*, spores of *Algæ*, &c. The stem is many times longer than thick, and it is tubular, the calibre being about 0·003 mm.

Clathrulina multiplies itself much in the same way as *Actinophrys*, &c., viz., by scission, and the production of motile zoospores after having undergone the process of encysting; of course it is only the soft protoplasmic mass that participates in these processes. In either case the segments of the divided body, or the motile zoospores, escape through the *fenestræ*; and either at once, or after moving about for a short time, become affixed, and, secreting the *fenestrated* case, become *Clathrulinæ*.

The systematic relations of this interesting genus are too obvious to require remark, but, as the author observes, it is extremely interesting to find in it an intermediate form of Rhizopoda between Actinophrys and the Radiolariæ, as represented, for instance, by *Coscinosphæra* of Stuart,* which may, in fact, as he says, be described as a cased *Actinophrys* furnished with pigment-cells.

4. "*On the Origin and Development of Bacterium termo*, Duj., *Vibreo lineola*, Ehrb," by Joh. Lüders, of Kiel.

5. "*Remarks on the above paper*," by Dr. Hensen. The very interesting observations of Frau Lüders on the development of Vibriones from the spores and germ-filaments of various of the lower fungi were first communicated in the 'Botanische Zeitung' (1866, p. 33); and her results were commented upon, and strongly controverted, by Professor Hallier in the 'Archiv. f. Mikroskop. Anatomie,' vol. ii. p. 67, 1866.

The present paper by Frau Lüders is intended to support her previous observations, and to establish her conclusions upon fresh experimental grounds.

In the second brief communication by Professor Hensel, all that she says is strongly supported; and there can be no doubt that the subject is one demanding the earnest and zealous attention of microscopists.

Madame Lüders conceives that she has proved that Vibriones (leaving aside the question of there being more than one

* 'Zeitsch. f. wiss.,' Bd. xvi, Heft. 3.

species) are produced from the spores and germinal filaments of various fungi—amongst which are enumerated *Mucor*, *Penicillium*, *Botrytis*, *Torula*, *Manilia*, *Aspergillum*, *Septosporium*, *Arthrobotrys*, *Acremonium*, and *Verticillium*.

In Madame Lüders' experiments on the cultivation upon the stage of the microscope, either under a covering-glass or in the moist chamber, all the glasses employed, both thin and thick, were previously purified from all organic germs, by exposure to a strong heat in the spirit lamp; and in order to avoid both the drying of the preparation and the admission of foreign germs, they were kept under a glass bell, secured by water.

In cases where it was intended to kill the spores by dry heat, they were kept for fifteen to thirty minutes at a temperature of 160° C., for Madame Lüders has seen them germinate after they had been heated to only 100°, when placed for some days in flesh- or sugar-water.

The experiment farther consisted in the sowing in test-glasses, prepared as above stated, and filled with boiled flesh-water, at the moment they were taken from the boiling apparatus, the spores of the various *fungi* above enumerated, taken by means of forceps which had previously been heated to redness; the tubes were then closed with varnish, &c. When the tubes thus prepared were placed, immediately after the sowing, into the warm bath, a cloudiness was often observed in the fluid in the course of a few hours, and within twenty-four hours they always swarmed with *Vibriones*, whilst at the same time the contents of a similar tube, containing the same fluid, and prepared in precisely the same way, but into which no spores had been introduced, remained unchanged.

The *Vibriones* produced in this way by direct germination from the spores of *fungi* differ in no respect from those which are commonly found in putrescent fluids.

Madame Lüders is induced to believe that the blood of living animals contains *Vibriones*, either in the catenated form or in that of the constituent granules; but during life, and until putrescency commences, these are always quiescent, and show no signs of active existence.

An experiment, by Professor Hensen, in support of this opinion, is thus described:

The extremity of a glass-tube, bent in the form of a W with the ends drawn out, and quite closed, and which had been exposed for half an hour to 200° C., was thrust into the heart of a recently killed guinea pig, and then broken off. After the blood had been sucked into the tube from the

other end, which was melted off in order to remove any small quantity of fluid that might have entered in the process of suction, the ends of the tube having been hermetically closed, it was kept at a temperature of from 13° to 15° C.

From one of several tubes thus prepared, on the 8th Nov., 1866, the point was broken off on the 10th, and on the following day a drop of the blood was expelled by warming the air contained in it. Microscopic examination showed that this blood contained numerous fungus-germ-vibriones, in the form both of isolated granules, as well as in that of rods or chains; mobile rods, however, were rare. On the 12th the latter had become more numerous, and their motions were much accelerated on the addition of water.

Milk also contains the minute, isolated germs of vibrios in still greater abundance, and which, as in the case of the blood, are motionless until putrescency commences. As might be expected, cheese contains them in greater abundance even than milk, as may be proved by placing a bit of cheese in water, which soon becomes filled with active vibrios, which correspond in every respect with what M. Pasteur describes as the butyric-acid ferment.

Similar germs are also found in the yolk of eggs treated in the same way as the blood in the experiment above related; and Madame Lüders thence remarks that it is by no means necessary to conclude from M. Donné's experiments, in which the access of extraneous spores to the egg was prevented, that the Vibrios found in it were the product of spontaneous generation.

In the mouth and on the epithelium of the tongue the Vibrio-germs occur in the form of *Leptothrix buccalis*, Remak. When *Leptothrix*, or fungus-spores, are cultivated in pure water, the rods, it is true, exhibit but very faint indications of movement; but when placed in flesh- or bloody water, they multiply and present all the phenomena witnessed in the Vibriones produced in such *media* from the spores of moulds, or in those which arise spontaneously in putrifying fluids.

The facts first made known by Professor Hallier, that, under certain circumstances, Yeast may be produced from Leptothrix, has received confirmation from Madame Lüders' researches, as have also the statements of Bail, Berkeley, and Hoffmann, that yeast can be produced from the spores of various moulds. In experiments on this subject much depends on the composition of the fluid, the amount of germs introduced into it, but, above all, on the temperature.

The mixture which afforded the best results contained from 12 to 16 parts of cane-sugar to 100 of water. When

this solution, after having been heated to 140° C., is examined microscopically, the minute germs which it always contains are seen to be still browner than the fluid, and they never germinate. The solution, consequently, in this condition is fitted for further experiment with the spores of various fungi. When these have been introduced the tubes should be placed in a bath at from 30° to 40° C., which should be maintained as nearly as possible uniform. In three or four days yeast will be abundantly formed. The spores of *Penicillium glaucum* appear to afford the most certain and copious results, whilst from those of *Mucor*, *Aspergillus*, *Arthrobotrys*, *Verticillium*, and *Acremonium*, it is more difficult to produce yeast in pure sugar water, especially when the spores are at all old. But the addition of a little fruit-juice at once promotes its production.

The results at a lower temperature are widely different. Even at the temperature of 25° C. an extraordinary quantity of thick germ-filaments are produced, which, as it were, absorb the entire plasma for their own nutrition, and consequently few or no granules are afforded.

In similar manner it would seem that the yeast-cells may be produced from the Vibriones of a putrescent fluid in the course of forty-eight hours. In this experiment care must be taken that too great a quantity of the Vibrio-germs should not be introduced into the sugar solution. *Vice versâ*, on the addition of yeast-cells to a putrescent animal fluid, the production of Vibrio-germs from them may be witnessed.

In the few observations appended to this valuable communication by Madame Lüders Professor Hensen gives his testimony as to the patience, perseverance, and care with which the experiments were performed, many of which were repeated by himself with similar results. He remarks also upon the fact, deducible from all recorded observations on the subject, that the germination of fungi, the formation of yeast-cells, and of Vibrios, never proceed at one and the same time and spot, but are always successive—one form disappearing as the other comes upon the stage. In illustration of this general law he cites a valuable paper by Oehl and Cantoni,* who, in their researches with an extract of beans, invariably observed, after the disappearance of the *Vibrio-fauna*, the entrance of a *flora*, eventually passing into the development of fungi.

6. *A Contribution towards the Knowledge of the "Sacculi of Miescher."* By Professor W. Manz.—Miescher's Sacculi

* 'Annali universali,' vol. cxcvi, p. 352, "Riccherche sullo sviluppo degli Infusori."

are the minute bodies which occur in muscular tissue, and which were known as "Cattle Plague Entozoa" in this country a year or two since. They have, of course, nothing to do with cattle plague, and were well known to the German microscopists twenty years since, and have also been described by Mr. Rainey, who regarded them as embryo-cysticeri, from the pig, in 1859. Dr. Beale's paper in the 'Med. Times and Gazette,' in which he described these sacculi very carefully at the time when they attracted attention in England, is not referred to by Professor Manz. It is a very strange thing that not one of the writers on these animals (which evidently belong to the group of Gregarinida) has given them a name. We offer that of *Sarcocystis Miescheri* for the use of future writers. Professor Manz observes that the common cylindrical form of these vesicles depends entirely on their size; and the change of size is the consequence of a development which takes place longitudinally; the thickness does not depend upon this; they are sometimes broader and sometimes narrower than the primitive bundle of muscular tissue in which they occur. The tunic of the sacculi is composed of a fine homogeneous membrane which surrounds its contents pretty close. From some observations made on decomposing sacculi, the author thought the tunic was very porous, but in fresh subjects I could discover no trace of such a condition.

Smaller *sacculi* from the pig were observed, which were acuminate at one, or, more frequently, at both ends; and at these points a conical space was left containing no reniform corpuscles, but only brilliant granules. A very important character of the tunic of the *sacculi* is the presence of a ciliary investment, which was first described by Mr. Rainey. This exists, however, only on the smaller or younger sacculi; it is of a very delicate nature, and may easily be detached in the extraction of the *sacculus* from its site. Its aspect conveyed to the author the same impression that it has done to Leuckart, viz. that it is due to a cuticular fissuring or striation, rather than to the existence of actual *cilia*, for ciliary movement has never been witnessed in it.

The contents of the *sacculi* consist of a homogeneous, very transparent, gelatinous substance, in whichare imbedded the well-known kidney- or bean-shaped corpuscles. But besides these the author has noticed bodies of a crescentic form, and pointed at each end; and also, but more rarely, straight rods, and, lastly, spherical corpuscles. The latter appear to have a special significance, inasmuch as they represent the earlier stage of development of the others. They are found chiefly, if not exclusively, in the smallest *sacculi*.

In appearance not unlike the colourless blood-corpuscles, these bodies at first appeared pale, with faintly granular contents and ill-defined *nucleus*. But when placed in dilute glycerine their aspect soon changed, owing to the retraction at one spot of the contents from the now distinctly visible membrane, the contents presenting a defined outline, whilst at the same time the vacuole-like *nucleus* was also more distinctly seen. This condition, however, did not last long; the membrane soon bursting, the contents escaped in an elongated form, and assumed the character of the well-known reniform corpuscles, which are thus seen to arise from the direct transformation of the contents of a *cell*. That this phenomenon is a normal one, and indicative of a normal process of development, is shown in the circumstance that the reniform corpuscles are found in *sacculi*, lodged in perfectly fresh muscle. With regard to the structure of the reniform corpuscles, the *nucleus*, as remarked by Hessling, rather appears like a division of the protoplasm; but, from the part it takes in the scission of the corpuscle, it must be regarded as a true *nucleus*. It is, without doubt, vesicular, usually solitary, and placed in the middle of the corpuscle towards its concave side. Other smaller, probably fatty particles, or minute vacuoles, are seen in the pointed extremities of the corpuscle. The corpuscle does not seem to be furnished with a membrane, the existence of which would scarcely be reconcilable with the above-described mode of its *genesis*. Hessling states that he has often witnessed division of the corpuscles. The author has sometimes, in corpuscles from the smaller-sized *sacculi*, noticed the appearance of a delicate line crossing the *nucleus*, and probably betokening its division. Besides this, he has frequently observed what may be regarded as the last stage in the process of scission, viz., two corpuscles in close apposition by their concave sides, and still attached to each other at one end, but both of which presented the fully developed reniform shape. As nothing like a membrane could be seen surrounding these twin corpuscles, he concludes that the scission does not take place within a cell.

The movements of the corpuscles appear to depend altogether upon external agencies, such as currents in the fluid in which they may be placed, or upon the molecular motion or the minute brilliant particles to which some are attached by delicate filaments.

The corpuscles, when within the *sacculus*, are imbedded in a matrix, which is subdivided into separate segments, which, as long as they remain enclosed, have a polygonal shape from their mutual pressure, but, when freed, assume a globular form.

Amongst the animals (which other observers say are inhabited by psorospermian vesicles) the author has found them in the deer, ox, mouse, rat, and pig, but never in the human body. He always found them inhabiting the transversely-striped muscles, and in no other organ or texture. They are, like the Trichin, found in great numbers at the commencement of the tendon of the muscle. If in large numbers, they are found in almost every muscle of the animal. It is also to be remarked that where they are few and small, they occur chiefly in the peritoneal covering and the regions about the stomach. According to the size of the vesicles so is the number; where they are few they are small—from a quarter to one line in length; and where numerous, larger, even two inches long. As to the exact time of year of their appearance the author is uncertain, for he was not able to carry on his observations during a whole year. He can only say that in the early months of last year he examined a great many animals, and found numbers of the cysts both in rats and pigs, whereas in the following summer until August he found none; but from August to October they appeared again, though only of the small or very smallest size. To prove the manner in which these parasites are communicated, he made numerous experiments, placing them in wet earth, in sugar-water, and leaving the flesh in which they were found to putrify or to dry; but in all these experiments the *sacculi* perished, or rather the contents, which underwent a sort of granular disintegration, usually even before the muscular structure itself had disappeared. He then tried feeding different animals on flesh which contained them, but when these were opened he simply found remains of the vesicles in the stomach, but no trace of them in the muscles.

Although these results were all negative, and although he has not met with any of the granular bodies in the flesh of the heart, which Hessling believes to be the young stage, the author thinks that the different *sacculi*, which are found in various animals, simply indicate degrees of age, which are distinguished by the absence of *cilia* and the comparative abundance of the spherical or of the reniform corpuscles.

Since he has ascertained from direct observation that the reniform or fusiform corpuscles are developed in the spherical cells above noticed, from which they are subsequently liberated, and, moreover, since in the *sacculi* of the smallest size only these spherical cells with uniform granular contents are met with, there can be no doubt that those *sacculi*, in which the spherical cells predominate, are younger than those containing the fusiform corpuscles. But it is precisely the sacculi, in the former condition, which are almost invariably furnished

with cilia, which organs, on the other hand, are wanting in those of the largest as well as in those of the smallest size. The occurrence of the ciliated investment in the young *sacculi* suggests the question whether the *cilia* may not have something to do with their migration? As yet we know nothing with respect to the *form* under which the parasite penetrates into the muscular substance, whether in that of a sacculus, or whether, as would appear probable from Hessling's observation, the saccular membrane be not developed secondarily around an aggregation of *psorosperms*, or perhaps of the spherical cells, their parents, which had previously penetrated. As regards the latter point, he has no facts to adduce, and in support of the former has only a single observation to record. In a *sacculus* of the smaller size, taken from the diaphragm of a pig, one end of it appeared to be produced into a filament about four times the length of the *sacculus* itself, and continued in a straight line with it, parallel to the long axis, and through the otherwise untouched striated substance of the fasciculus. But what was at first taken for a filament turned out, upon closer inspection, to be merely a narrow fissure in the muscular substance, which gradually widened as it approached the *sacculus*. The suggestion at once arose whether this fissure might not represent the accidentally remaining vestige of the passage of the *sacculus*. The explanation, however, is given with reservation, as the appearance in question was only observed once.

Although the author has not been able to say anything positive as to the way in which the vesicles penetrate the muscles, he thinks, considering their being so like the Trichina, and also that they are generally found in the neighbourhood of the stomach, that we may pretty safely conclude that it is through some part of the alimentary canal that they first enter the body. It is also certain that they are conveyed from here by some means to different parts of the body; why not by the blood-vessels? He has himself only observed one case which in any way would prove this; a young sacculus was found very close indeed to an artery in the diaphragm. Nothing however can at present be positively stated until the whole history of the development of the sacculi is known.

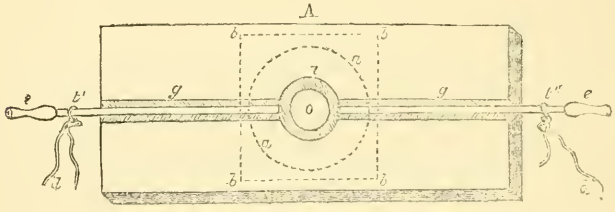
7. "*On the Structure of the Human Conjunctiva*," by Professor Ludwig Stieda.—The author's observations, founded upon sections in various directions of the conjunctival mucous membrane, show that it presents numerous deeper or shallower grooves or furrows, which pervade it in all directions, and are lined with a cylindrical epithelium, whilst the intermediate parts of the surface are covered with a scaly epithe-

lium. By the existence of this structure, he thinks, may be reconciled the somewhat conflicting views of anatomists respecting the structure of the conjunctiva. By it he also explains the appearances which have induced Henle to imagine that it was furnished with innumerable glandular follicles, inasmuch as in vertical sections of the membranæ the appearance afforded by the deeper furrows is precisely that of mucous follicles. Sections parallel with the surface are requisite to show the true structure.

8. "*Description of a Gas-Chamber for Microscopical purposes.*" by Dr. S. Stricker.—It is often desirable to be able to examine certain objects exposed to various gases, and also to be able to pass a galvanic current through them or the fluid in which they are immersed; and it may be added that an apparatus suitable for these purposes might be made available for the application of various chemical reagents to objects contained in a close chamber under the microscope.

These objects appear to be very ingeniously and, he says, comfortably carried out by Dr. Stricker's contrivance, which may be thus briefly described with the aid of a woodcut:

In the middle of a piece of thickish plate glass of suitable dimensions (A) a circular groove (*r*) is cut, and from this a



straight furrow (*g*, *g*), of the same depth, to each end. In each of these furrows is placed a slender metallic tube (*t'* and *t''*), preferably of platinum, and each having at its extremity a small bulbous enlargement, for the purpose, when needed, of affixing caoutchouc tubes. These metallic tubes are cemented into the furrows by means of shellac or other suitable cement, and thus serve as the sole means of communication with the circular furrow (*r*). The whole surface of the glass is now covered either with a layer of paper or of some varnish, but in either case has a circular space left open in the centre (*a*, *a*). The object of the paper or other covering is to keep the covering glass (*b*, *b*, *b*, *b*) at a suitable distance from the central circular portion of glass (*o*) upon which the object to be examined is placed. The mode of using this

simple contrivance will be readily perceived. When it is desired to apply a current of gas of any kind, or of a fluid, it will be readily carried through the tubes and central space by suction at one of the tubes, or by forcing the gas onwards. In the same way the tubes, either of themselves or as admitting the passage of a fine wire, may be made to conduct a galvanic current, when brought into connection through the wires (*d*, *d*) with the poles of a battery.

The covering glass is secured round the edges by a little softened tallow.

9. "*Spongological Notes*," by Oscar Schmidt.—In a very brief communication O. Schmidt makes some remarks on the structure of the Halisarcinæ, founded mainly upon *H. guttula* and *H. lobularis*. He has ascertained that in the interior of these sponges there is an internal sarcodous network, and also an external layer, which are continuous with each other. This network encloses numerous irregular vacuities, which are quite distinct from the ciliated true canals. He points out certain points of analogy between these forms and the Gummineæ.

Among the calcareous sponges he notices a new Sycon-like form, with the characters of *Dunstervillea*, in which latter he states that he has as yet been unable to detect the non-ciliated canals described by Kölliker. He has confirmed his previous observation that *Nardoa* is, if not always, yet frequently, furnished with *oscula*.

With respect to the siliceous sponges, the author remarks that a new species of *Scoparina* shows, from the same locality, the extreme variability of the *spicula*, and that thus some doubt may exist as to the value of the specific characters derived from these elements. In conclusion, he states that Lieberkühn's *Halichondria* (*Myxilla*) *anhelans* is not a species, but composed of two distinct forms, for which, separating them from *Myxilla*, he proposes the names of *Reniera inflata* (blue, with only one kind of spicules) and *R. muggiana* (brownish, with the spicules described by Lieberkühn).

Siebold and Kölliker's Zeitschrift.—The fourth part of this journal for the year 1867 contains the following microscopical papers, which we cannot notice in this number:—1. "*Researches on the Natural History of the Worms. On Chætosoma and Rhabdogaster*," by Elias Metschnikoff. 2. "*Studies on the Development of the Sexual Glands in the Lepidoptera*," by Dr. E. Bessels. 3. "*On the Muscles of the Cyclostomians and Leptocardians*," by H. Grenacher. 4. "*On the Semicircular Canal System in Birds*," by Dr. C. Hasse.

Sitzungsber d. Wien. Akad. June, 1867.—"*Observations on*

the Morphological Constitution of the Red Corpuscles of the Blood," by Professor Brucke.

On treating the red corpuscles of the blood of the Tritons with boracic acid, Brucke found that they consist of two distinct parts, which he names, the one *zooid*, the other *œcoid*. Having cut off the head of a living Triton, he let the blood drop into a solution which contained one part of boracic acid dissolved in one hundred parts of water; the globules fell to the bottom, and were examined with the immersion lens of Hartnack. Then were recognised two parts—the one uncoloured and diaphanous, which is the œcoid; the other coloured with the colour of the globules, which is the zooid. At first the zooid is completely within the œcoid, then it is implanted upon it, and finally in many cases it becomes entirely separated. The œcoid is not the supposed membrane of the globules, for there is no sudden rupture, but a gentle development, by which the zooid separates itself from the œcoid. The œcoid is a soft substance which takes a spheroid or ellipsoid form during and after the act of separation; sometimes there is to be seen the vestige of a crater in which the zooid was last implanted before separation.

The zooid is made up of two different parts—of a nucleus which can be seen in the living corpuscle as a colourless elliptical spot, and of a part of the corpuscle which contains all the hæmoglobin (cruorine), and which in the living state is spread out in the entire globule, but contracts itself round the nucleus under the influence of boracic acid, Sometimes there may be seen coloured prolongations of the zooid in some number, which pass to the periphery of the œcoid, which then has preserved the form of the globule almost unaltered. It seems, therefore, that the tracts, according to which the coloured substance of the zooid is distributed in the globule when alive and whole, are disposed in a radial manner; and that the form of the living corpuscle is the consequence of the intimate junction of the zooid with the œcoid; in fact, that this changes its form during the separation not by a vital act, but as the result of the same physical causes by which fluid masses floating in fluids of the same density tend to assume the spherical form. The action of boracic acid on non-nucleated corpuscles is said to be very curious, but it is not given in detail.

Bibliotheque Univers. Oct., 1867.—"*The Development of Sepiola*," by Elias Mecznikow.

A notice of this memoir, which appeared in Russian, is given by M. Claparède. Van Beneden and Kölliker have investigated the embryology of the Cephalopoda, but have

left something to be done. The ova of Sepiola are oblong in shape, and contained, to the number of fifteen or sixteen, in a thick mucilage. The ovum has but a single envelope, which is not the vitelline membrane, since it is furnished with a micropyle, and must hence be regarded as a true chorion. The ova are quite transparent, and their development lasts from thirty-four to thirty-five days. Three periods are distinguished by the author—to the completion of the blastoderm, ten days; formation of organs, five days; development and completion of organs, twenty days. The two lamellæ of the blastoderm form on the third day, and by the eighth day its growth envelops the whole ovum. The single layer of cells in each lamella execute very marked amœboid movements. At the commencement of the second period the cells of the outer lamella of the superior part of the blastoderm become covered with vibratile cilia, the movements of which cause a rotation of the embryo. The demarcation of the fœtus from the vitelline vesicle placed above it gradually proceeds, and the rudiments of eyes, mantle, arms, &c., appear. These organs are formed chiefly at the expense of the inner lamella. The nutritive-vitellus at the end of the second period presents a projection corresponding to the mantle; it also gives off two prolongations into the cephalic sinuses, beneath the optic ganglia. The author denies that this vitellus is surrounded by the proper membrane described by Kölliker. In the third period the growth of the organs is the chief feature. The nutritive-vitellus is absorbed little by little into the body of the fœtus, and finally only represents a sort of wart upon the head between the bases of the arms. The cartilaginous skeleton of the head is now developed, whilst about the same time the chromatophores develop in the skin, and the rudiments of the cuttle bone make their appearance. The two lamellæ which play so important a part are called by M. Mecznikow epithelial (exterior) and parenchymatous (interior) lamellæ. The first gives rise to the general envelope of the body, the cartilages, the organs of sense and digestion, and the inkbag. The inner layer gives origin to the muscles, the nervous system, the mass of the pharynx, and the vascular system. These lamellæ correspond exactly to what M. Mecznikow has described in the embryo of the scorpion.

It appears from this that the formation of the nervous system of the *Sepiolæ* cannot be paralleled with that of the same system in the Vertebrata. On the other hand, the formation of the skin and the organs of sense is effected, as in Vertebrata, at the expense of the internal lamella.

Hensen's observations on chickens seem also to authorise a parallelism between the formation of the internal skeleton of *Sepiolæ* and that of the *chorda dorsalis* of Vertebrata. M. Mecznikow rejects all analogy between the foot of the Cephalophora and the siphon of the Cephalopoda. He is equally adverse to Häckel's hypothesis, according to which the Pteropoda are the ancestors of the Cephalopoda.

Robin's Journal de l'Anatomie et de la Physiolgie. September and October.

1. *On the Peripheral Termination of Motor Nerves.* By Professor S. Trinchese, of Genoa. This paper is illustrated by four very clear and well-drawn plates, in which are figured the "plâques motrices" of various animals in connection with the terminating nerve-filament and the sarcolemma of the muscle-fibre—Echinoderms, Molluscs, Fish, Reptiles, and Mammals.

These corpuscles are considered by the author to be, without doubt, the terminal bodies of the nerves, and he remarks that they are held to be so by Doyère, Quatrefages, Rouget, Kühne, Krause, Engelmann, Waldeyer, Greef, and Moxon, whilst only Kölliker and Beale refuse to believe in them. The first-named authors are only disagreed as to the connection of the *pláques motrices* with the cylinder axis. Professor Trinchese's paper, though interesting in many ways, does not throw that light on the subject which a careful examination of these bodies in connection with the *different methods of preparation* used by various authors, would do. He has used very dilute hydrochloric acid as a reagent, and a power of only 300 diameters. It is obviously most unfair in this case, then, to speak of Dr Beale's researches in the slighting manner which he makes use of. He says that Dr. Beale's beautiful drawings give but a confused idea of his observations, and are unlike what can be seen. Now, nearly all impartial observers must admit the faithfulness of Dr. Beale's drawings; he has drawn only what he has seen; there is nothing diagrammatic in them, as in Professor Trinchese's. Dr. Beale has used a power of 1500 diameters and elaborate methods of preparation; and only one who will do the same has a right to pronounce upon the truth of Dr. Beale's views. It is not at all improbable that the two views of nerve termination, as to *networks* and *terminal plates*, may then be reconciled. Professor Trinchese's observations may be taken for what they are worth—as observations made with an ordinary power of 300 diameters—but cannot prove that *more* than what he has seen cannot be seen.

Professor Trinchese states his conclusions as follows:—

1. In all animals in which it has been possible to study the termination of motor nerves, a special organ has been found, named the "motor plate" (*plâque motrice*), at the extremity of the cylinder axis. 2. The union of the nervous element with the muscular bundle is accomplished in the following manner. When the muscular bundle is provided with sarcolemma, and the nervous element with a sheath, this latter becomes fused with the envelope of the primitive muscular bundle, at the point where the nervous element meets the muscular bundle. At this same point, or a little before, the medullary substance stops, whilst the *cylinder axis* pursues its course, and penetrates the "motor plate." 3. The motor plate is placed beneath the sarcolemma. It presents usually the form of a cone, with its summit directed to the side of the nerve-tube, whilst the base is applied to the primitive muscular fibres. 4. This plate is formed by two superposed and very distinct layers, especially in those animals provided with large "plates," as, for instance, in the torpedo. The substance of the superior layer is granular, that of the inferior layer is perfectly homogeneous, and probably it is nothing more than a thickening of the *cylinder axis*. 5. In the substance of the granular layer of the plate is found, in the torpedo, a system of canals, in which the cylinder axis ramifies, forming a coarse network. These canals are limited by a sheath, which forms their walls. 6. When the muscular bundles possess a central canal, the granular substance of the plate is continuous with the granular substance contained in this canal. 7. In animals provided only with smooth muscular fibres the *cylinder axis* traverses the granular substance of the plate, dividing itself into two filaments, which pass to the two extremities to terminate in the points of the contractile element. 8. Everything tends to the belief that each primitive muscular fibre has but one motor plate. In this, one or several nervous elements can terminate, arising from the subdivision of one and the same nerve-tube. 9. The diameter of the motor plate augments in proportion to the thickness of the primitive muscular bundle.

In Dr. Beale's new edition of his work 'On the Microscope,' recently published, a reiteration of his views will be found, and a defence against such attacks as this of Professor Trinchese.

November and December.—1. "*Memoir on the Anatomy and Zoology of the Acari, of the Genera Cheyletus, Glyciphagus, and Tyroglyphus*," by MM. A. Fumouze and Ch. Robin.

This is the continuation and finish of a very detailed and

no doubt valuable account of these genera of Acari, illustrated with several plates.

2. "*Histological Researches on the Genesis and on the Structure of the Capillaries*," by Dr. Stricker, of Vienna, notice by M. Ominus.

Dr. Stricker, from investigations on the capillaries of the tadpole and frog, is led to very interesting results. The nictitating membrane of the frog was found very well adapted for observation, since its vessels remain filled with blood when it is cut away, and it is easy to see the walls of the capillaries. Dr. Stricker maintains that there are perivascular spaces around the capillary vessels, confirming the opinion of Robin, and others who have demonstrated them by injection. Kölliker's supposition that the perivascular spaces were post-mortem products is answered by Dr. Stricker's observations on living frogs. The contractility of the walls of the capillaries was observed also, and it is urged as likely that they would have independent contractility, since they are formed by *protoplasm* that simplest of elementary tissues which Max Schultze, Haeckel, and Brücke have described as essentially a contractile substance. M. Ominus remarks that protoplasm, used in this sense, viz., as forming the moving substance of diatoms, mycetozoa, white blood-cells, and sarcode more or less, must not be confounded with the old restricted use of the word, in which it means the intracellular substance merely in vegetables or embryonic animals. The capillary wall is then not to be regarded as structureless, but as modified protoplasm, producing fresh capillary branches by giving off processes. Further, Dr. Stricker has observed blood-corpuscles traverse, and in the act of traversing, the capillary-wall, which can only be accounted for by the hypothesis of innumerable perforations, or of a jelly-like consistency, which is the view Dr. Stricker takes. As to the fact of the capillary wall being penetrated and traversed by blood-corpuscles, he is confirmed very fully by his pupil M. Prussak. Dr. Stricker has observed in studying inflammation in the brain of the fowl, that capillaries may be produced and branch out in all directions from those normally existing, thus increasing greatly the vascularity of a tissue.

The use of injections of nitrate of silver is interesting, as demonstrating different chemical properties in this and that part of the capillary vessels, but cannot, Dr. Stricker believes, be considered as indicating any particular embryological development.

Dr. Stricker then concludes that the finest capillary vessels

are formed of protoplasm in the embryo, and the same in the adult, at any rate for a great part of their thickness. With high powers granulations may be detected here and there, just such as may be observed in protoplasm. The conditions which determine the contractions of the finest capillaries are not known, nor are those which determine the contractions of protoplasm in other forms of life.

Mem. Acad. Imp. de St. Petersb.—"*On the Anatomy of Balanoglossus*," by M. A. Kowalewsky.

Under the name of *Balanoglossus*, Delle Chiaje described a vermiform animal of the Bay of Naples, known to the fishermen as *lingua di bue*. It has since attracted but little attention from naturalists, and the very incomplete investigation of it made in 1860 by M. Keferstein taught us nothing of importance about it. Balanoglassus, according to M. Kowalewsky, is a vermiform animal having its body composed of a series of successive regions—of which the first is a tactile organ, the second a mouth-bearing muscular collar, the third a branchial region, presenting within a perforated sac, like that of Ascidians, and apertures above, by which the water taken in at the mouth is expelled; the fourth region bears the sexual glands, and succeeding it are numerous papillæ, into which diverticula of the intestine pass; lastly, there is a smooth, finely annulated caudal region. The vascular system is simple, consisting of a dorsal vessel impelling the blood forward, and a ventral vessel carrying it in the opposite direction. M. Keferstein has ascribed to these very interesting animals a position amongst the Nemertida, whilst M. Kowalewsky especially approximates them to the Annelida. Another writer considers it necessary to make the Balanoglossi a distinct group of Vermes, allying that sub-kingdom to the Vertebrata. It will hardly do, we think, to refer every animal with a segmented body to Vermes, without reference to other structural characters.

Annals of Nat. Hist. November.—"*On the Structure of the Annelida*," by E. Claparède.

Professor Claparède is without doubt one of the most careful and reliable of zoological observers; he is eminently well fitted to undertake the decision of disputed questions, and his observations and opinions have the very highest authority. During a sojourn of some six months at Naples, he has, in spite of the ill-health which caused him to go there, investigated minutely the Annelida of the Bay, and has now in the press a work on these animals, which is to be illustrated by thirty-one quarto plates of his beautiful drawings. In this

paper he gives a brief summary of some of his results, more especially criticising the statements lately put forward by M. de Quatrefages in his volumes on the natural history of the Annelids. He pays a high tribute to Delle Chiaje, for he remarks, "In every page in the course of this memoir I shall have to bring Delle Chiaje out of the undeserved obscurity in which he has too often remained immersed, and to show him shining in the front rank. I hope I shall not be accused of partiality in his favour. If I often leave his errors, which, I admit, are numerous, in oblivion, it is because they have no influence on the progress of science." M. Claparède is very severe on M. de Quatrefages for neglecting the bibliography of his subject, and for not fully verifying references, &c., and he also condemns (as we had occasion to do) the numerous new species which he has made from specimens preserved in spirit in the Paris museum. In the present sketch of his own work, M. Claparède gives a running comment on the 'Histoire Naturelle des Annelés,' and discusses various points in their order of treatment in that work. We can here notice only one or two points. The integument is described by Professor Claparède as composed of two layers—one internal and cellular (*corium*, Rathke), corresponding with the subcuticular or chitinogenous layer of the other articulata; the other extracellular, the cuticle (*epidermis*, Rathke), sometimes very delicate, and sometimes composed of a thick layer of chitin. Kölliker is the author who has studied the integuments carefully, but his observations are not mentioned by de Quatrefages. The cells of the hypodermis are often not well defined, but present scattered nuclei in a granular stratum, as has been seen in some Arthropoda. The cuticle when thick presents a double series of striæ crossing at right angles, which have been well observed by Kölliker. The tubular pores which perforate the integument, when they exist, are distributed in lines congruent with these striæ. Kölliker doubted whether these pores should be compared to the tubular pores (Porenkanäle) of the Arthropoda, or whether they were the apertures of cutaneous glands, such as those described by Leydig in the Piscicolæ, or, again, might they represent the hairs of insects and crustacea? Claparède states that the two categories of pores exist in Annelida, and he has described them minutely in *Eunice*—both large glandular pores few and scattered, and minute numerous canal-pores. In the subcuticular layer exist glandular follicles in all parts of the worm, discharging themselves outwards by the large scattered granular pores; some of these

secrete only a thick liquid, others produce bundles of bacilli in their interior, others, again, secrete granules. The bacilliparous follicles have been described by M. Claparède (who compares them to cells filled with aciculæ in Turbellaria, and to Nematophores) and by other authors in very many genera. They are not mentioned by de Quatrefages.

The muscular tissue varies very much, being sometimes simply fibrous, sometimes nucleated, and sometimes an unfibrillated protoplasmic mass, with scattered nuclei. M. Claparède promises details on this subject.

The perivisceral cavity is in some cases throughout lined with cilia, but by no means always; certain points, such as the segment organs, being often the only ciliated parts. The ciliation is stated, as a rule, to be general only in those genera which have no vascular system.

The following are anangian Annelids:—All the Aphroditea (except *A. aculeata*), Glycerea, Polycirrida, and Tomopteridea. The existence of blood-corpuscles in the *vessels* of certain Annelida is now-a-days indubitable. In *Glycera* the red corpuscles are floating in the perivisceral cavity, no vessels existing (hence a condition very similar to that of a Vertebrate is brought about), and *Phoronis* is denied a place among Annelids by M. Claparède. The true cases are to be found among the Syllidea, in the Opheliea, the Cirratulea, and Staurocephalæ.

M. Claparède promises some important details on the generative glands and segment-organs. He maintains that a connective-tissue framework and vascular supply can always be detected as the origin of the ova and sperm-cells. Figures of segment-organs from many species will be given. In some genera they are represented by apertures. Their functions may be partly educatory of generative products and partly excretory.

The structure of the nervous system has also been carefully investigated, and a follicular arrangement such as that described by Leydig in the Hirudinea, observed in many genera. The terminations of the nerves both in organs of sight and hearing, and tactile corpuscles, is very fully to be entered upon. Victor Carus is wrong in stating in his 'Handbuch' that nearly all Annelida have auditory capsules.

Remarkable observations on the regeneration of lost parts are referred to. In many cases M, Claparède has no doubt that the anterior region, both *head* and many succeeding segments, is reproduced.

Altogether from his own account of it, M. Claparède's

forthcoming volume (in the Soc. de Phys. and Hist. Nat. de Genève) promises to be a most valuable and important work, perhaps exceeding in value, if that be possible, his former essays on the Oligochœta, Development, &c.

Boston Society of Natural History (America).—"*On the Spongiæ Ciliatæ as Infusoria Flagellata; or, Observations on the Structure, Animality and Relationship of Leucosolenia botryoides*, Bowerbank, by H. James-Clark, A.B., B.S. We have already had occasion to notice a portion of this memoir, which appeared a few months since, but wish to draw attention to the paper in its complete form, which has a very high interest, and should be carefully read by those interested in the lowest forms of animals. Two plates illustrate the memoir, which are certainly more satisfactory than the white and black outlines which illustrate the author's first series of observations.

Professor James-Clarke has applied a power of 1200 diameters to that form of life which is usually spoken of as a "Monad," in fact, the *Monas termo* of Ehrenberg. In this very common and minute creature he has demonstrated a mouth, contractile vesicle, and nucleus spot, which has not been recognised by previous observers. By a gradual series of forms he passes from this *Monas*, which sometimes is free, and sometimes attached by a short stem as are Vorticelli, up to the ciliated sponges, the individual elements of which he most clearly shows may fairly be regarded as Monas-forms. Some forms closely allied to *Monas* present a projecting cup or calyx surrounding the oval end of the creature, and from within it arises the flagellum. New genera and species presenting this calyx structure, and varying in aggregation from solitary to compound animals of five or six, are described, and these gradually lead on to *Leucosolenia*, a ciliated sponge in which the calyx, flagellum, and mouth are traceable in the cell-like monads embedded in the sponge tissue, which build it up as a colony of compound Actinozoa build up a coral reef. Mr. James-Clark's paper also contains some observations on *Dysteria*, that very strange flagellate Infusorian first described by Prof. Huxley in this Journal, and a description of a remarkable new form, *Heteromastix*. The author's conclusions may be accepted so far as they prove a close relationship in elementary structure between the ciliated Sponges and flagellate Infusoria, but we do not know that as yet there is any ground for a change in the classification of either group on this account. We have one deficiency to note in Prof. James-Clark's treatment of his subject, and that

is, that he has not given measurements of his Infusoria, but has satisfied himself by stating the diameter-power of the glass used. It would be well just to state, in fractions of an inch or millimetre, the size of the various objects, or to give a scale of thousandths of an inch on the plate.

NOTES AND CORRESPONDENCE.

On a New Nozzle and Pipe for Injecting Syringes.—Having had many years' experience in the frequent use both of small and large injecting syringes, either for the injection of the whole animal or detached organs, I have frequently felt the great inconvenience of the ordinary plan of fixing the syringe on to the injecting pipe, and consequent need of some simple plan for keeping the pipe firmly attached to the syringe while in use. By the present method of fitting the nozzle of the syringe to the pipe it is generally necessary, more particularly when the syringe is large, to keep the left hand constantly on the pipe to prevent its being forced away from the syringe when any amount of pressure is being applied, thus preventing the hand being quite free to lift the specimen from time to time, to see how the injection is going on. When any extravasation takes place, and an assistant is not at hand (the operator wishing to have both hands quite free), it is not safe to lay the syringe with the pipe attached down, but the nozzle has to be detached and a cork placed in the pipe till the extravasating vessels are taken up. It also often happens that when considerable pressure is being applied to the syringe, and the hand is not kept firmly on the pipe, it is violently forced away from the nozzle, and the operator and articles about the room are smothered with injecting fluid. This happens very often with beginners, and is one of their greatest difficulties. I had for many years thought of various plans for fixing the pipe on the syringe, but had never hit on a satisfactory and simple method till I joined the volunteer force, and became acquainted with the method of fixing the bayonet to the long Enfield rifle, when it occurred to me that a similar arrangement was just what was required to remedy the evils I have enumerated.

A small pin is inserted into the nozzle of the syringe, sufficiently long to project a little way beyond a corresponding

slit in the pipe, when fixed in its place (fig. 1). A slit a trifle larger than the pin on the nozzle is carried a short distance down one side of the pipe, and then a short way across and slightly downwards, to allow the pin to tighten against

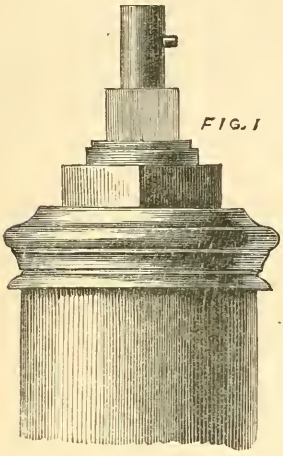


FIG. 1

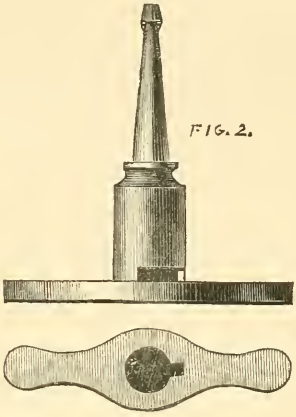


FIG. 2.

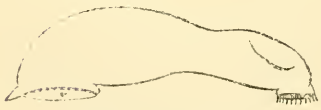
the edge of the slit without going right across, and also to allow for the slight wear which takes place in turning the syringe off and on (fig. 2). I have had several large and small syringes fitted with this simple contrivance, and if the fitting is carefully done there ought not to be any leakage, and the nozzle should twist off and on quite easily. — CHARLES ROBERTSON, Demonstrator of Anatomy, Oxford.

Note on the Synaptæ of Guernsey and Herm, and a New Parasitic Rotifer.—When in Guernsey last summer I had a brief opportunity of examining the Synaptæ so abundant in the sandy part of the shore there, and at the opposite island of Herm. Besides the differences mentioned by Dr. Herapath, in his paper in this Journal on Synaptæ, I noted one or two other points which distinguish *Synapta Sarniensis* from *Synapta inhærens* or *Duvernæa*. *S. inhærens* is of a much deeper rose tint, and its integument is tougher and less elastic than in *S. Sarniensis*. The colouring matter, when extracted with ether, did not furnish any marked absorption bands with the spectroscope in either case. An important distinctive character is found in the miliary spicules, especially those of the tentacles, in the two species. In *S. in-*

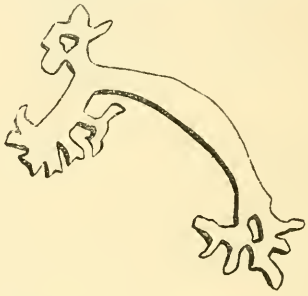
hærens these average $\frac{1}{300}$ of an inch in length, and are much branched and broken up at either end; in *S. Sarniensis*, on the other hand (in which the large wheel and anchor plates are the more ornate), the miliary spicules are very small, irregularly oblong rods, quite simple in form, and averaging $\frac{1}{500}$ of an inch in length. This is a most decisive differentia, and may be thoroughly depended on. It is a curious, and to me inexplicable fact, that *S. Sarniensis* occurs *only on the Guernsey shore*, with an occasional *S. inhærens* as an intruder; while exactly opposite, on the Herm shore, four miles distant only, *S. inhærens* occurs, and very abundantly.

I hoped to find the remarkable molluscan genus *Entoconchon*, described by Müller from *S. digitata*, in the Guernsey Synaptæ, but in a rather hurried examination failed. I, however, found a very remarkable parasite in the body-cavity of both the Channel-Island species in very great abundance,

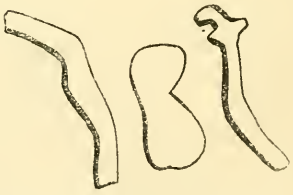
New Parasitic Rotifer.



Method of progression.



Miliary spicule from tentacle of *S. inhærens*.



Miliary spicules from tentacle of *S. Sarniensis*.

namely, a Rotifer. In the figure is given all that I could ascertain of the structure of the parasite at that time. It never favoured me with a view of its expanded discs, and was ex-

ceedingly small ($\frac{1}{300}$ of an inch), whilst the difficulty of close observation was further increased by the *débris* of the genitalia of the Synaptæ, with which it was always connected. Mr. Gosse has kindly given me his opinion as to the Rotifer, which he regards as likely to prove the type of a new genus; but no definite opinion is warranted by my fragmentary observation. Associated with the Rotifer in the body-cavity of the Synapta was also a very active *Trichodina*, very similar to that infesting the common *Hydra viridis*.—E. Ray Lankester, Christ Church, Oxford.

PROCEEDINGS OF SOCIETIES.

Royal Microscopical Society.

October 9th, 1867.

This was the first meeting of the season. The chair was taken by James Glaisher, Esq., F.R.S., and the attendance of Fellows was numerous.

The President announced that the Library of the Society (Room No. 5), King's College, Somerset House, would be open for the use of Fellows, on Mondays, Tuesdays, Thursdays, and Fridays, from 11 to 4 p.m.; on Wednesdays, in the evening only, from 6 to 10 p.m.; and on Saturdays, from 11 till 2 p.m.

The issue of volumes from the library he recommended to be suspended for the present, and steps taken to make the collection of books more complete. He likewise stated that the cabinet of slides was being rearranged to facilitate their use. The cabinet would be opened to Fellows as early as possible, together with the Society's collection of microscopes, but the issue of slides to Fellows as heretofore would be suspended.

Notice was given that a special general meeting would be held in the Library of King's College, at the close of the ordinary meeting to be held on the 13th of November next, at 8 p.m., to consider the following resolutions for altering the Bye-Laws, to be moved by Ellis G. Lobb, Esq.:

"Every Fellow who shall be elected after the meeting on 11th December, 1867, shall, in addition to the entrance-fee of two guineas, pay a further sum of two guineas as his first annual subscription; and shall pay, so long as he continues a Fellow, an annual subscription of two guineas, which shall be due on the 1st of January in each year; and that Bye-law No. 6, Sect. 2, be altered in conformity with this resolution."

"Every Fellow who shall be elected after the meeting on the 11th of December, 1867, and who may desire to compound for his future annual subscriptions, may do so by a payment of twenty guineas, in addition to his entrance-fee of two guineas; and that Bye-law No. 7, Sect. 2, be altered in conformity with this resolution."

The following donations were announced, and thanks voted to the respective donors:

	Presented by
Twenty slides of Gold from various parts of the world	T. Ross, Esq.
The Quarterly Geological Journal	The Society.
The Popular Science Review	The Publisher.
The Intellectual Observer. 3 Nos.	Ditto.
The Journal of the Linnean Society	The Society.
The Journal of the Society of Arts	Ditto.
The Floral World, by Shirley Hibberd	The Author.
The Proceedings of the Essex Institute	The Society.
The Proceedings of the Boston Natural History Society	Ditto.
The Results of Twenty-five Years' Meteorological Observations in Hobart Town, by Francis Abbot	The Author.
Report on Epidemic Cholera in the Army of the United States during the year 1866	Surgeon General.
A Handy Book to the Collection and Preparation of Fresh-water and Marine Algæ, Diatoms, Desmids, etc., by Johann Nave, translated and edited by the Rev. W. W. Spicer, M.A.	The Author.
A set of Photographs	M. J. Girard, Paris

The names of the following gentlemen proposed for election as Fellows were ordered to be suspended:

G. E. Legge Pearce, M.R.C.S. Eng., 2, St. George's Square; Peter Yeames Gowlland, F.R.C.S., F.R.Med.Chir.S., &c., 34, Finsbury Square; Charles Coppock, 31, Cornhill; H. Sugden Evans, Holland Road, Kensington, W.; and John Williams, Royal Astronomical Society, Somerset House, as an Honorary Fellow.

The following gentlemen were balloted for and duly elected:

Daniel Woodin, Peldon, Richmond; Henry Alexander Glass, Gray's Inn Square.

A paper was read by Dr. Guy, F.R.S., Professor of Forensic Medicine, King's College, &c., on "Microscopic Sublimation, and especially on the Sublimates of the Alkaloids." (See 'Trans.,' p. 1.)

The usual vote of thanks was passed to the author, and a short discussion followed, in which Dr. Carpenter, Dr. Silver, Prof. Tennant, and Mr. Hogg, took part.

Mr. J. Hogg, Hon. Sec., placed on the table a collection of Photomicrographs, the productions of Dr. Maddox, many of which were considered very fine examples of the art. Mr. Hogg said that Dr. Maddox had succeeded in showing, under a magnifying power of 3000 diameters, some of the peculiarities of the Pleurosigma, which, when attentively examined, must be thought to have the effect of unsettling the minds of those who, after repeated examinations with the best objectives, believed that they had finally succeeded in resolving their markings. Take for instance the *Pleurosigma formosum*, magnified 3000 diameters, printed for the stereoscope, a copy of a print sent to America; it is not printed deep enough: it nevertheless shows the white spaces as little ivory-balls suspended between the eye and

the object. Another, also imperfectly printed, and magnified 3000 diameters, shows short, abrupt, strongly-defined shadows, supporting, as it were, the areas—an effect produced probably by *interference* at the junction of the hemispheres. This print should be examined and compared with another of *Pleurosigma formosum*, which shows the valve under various powers from 700 up to 3000 diameters. There is a small bit of print on this card which is remarkable and valuable to those particularly interested in resolving markings. The print of *P. angulatum* presents some interesting points as to its structure. Some of the areas appear *quite round*, not hexagonal; bright angular points separate these nodules in the one case, converting them into divisional lines in another; and the curious point is, they are both from the same negative. With regard to this plate, Dr. Maddox observes that "the negative was a failure from the plate being dirty;" nevertheless it is very instructive in various points. The larger prints exhibited should be regarded rather as pictures than representations of the sharp outline figures seen in the microscope.

Nov. 13*th*, 1867.

James Glaisher, Esq., F.R.S., President, in the Chair.

The minutes of the previous meeting were read and confirmed.

The following presents were announced and thanks voted—

	Presented by
A Four Inch Object Glass	T. Ross, Esq.
Hogg on the Microscope, Sixth Edition	The Author.
Quarterly Journal of the Geological Society	The Society.
The Journal of the Society of Arts. 4 Nos.	Ditto.
Acta Universitatis Lundinensis. 3 Parts	Ditto.
Natural History Transactions of North Durham	Ditto.
Intellectual Observer	The Publisher.

Certificates in favour of the following gentlemen were ordered to be suspended:

George Potter, 7, Montpellier Road, Upper Holloway; Richard Bannister, Inland Revenue Laboratory, Somerset House; F. Thos. Baker, 184, King's Road, Chelsea, S.W.; Henry Owens, M.D., Croydon, S.; William Thomas Loy, Dingwell Road, Croydon, S.; the Rev. Frederick William Russell, M.A., Charing Cross Hospital; the Rev. Francis Pigou, M.A., 14, Suffolk Place, Pall Mall East; James Murie, M.D., Zoological Gardens, Regents Park; John Mayall, 224, Regent Street; James J. Simmons, 18, Burton Crescent, W.C.; Thomas Wilcox Edmunds, 32, Old Change; Frederick Clarkson Francis, 9,

St. Thomas Place, Hackney; John Hopkinson, 8, Lawn Road, Haverstock Hill, N.W.; John Barber, 29, Brunswick Gardens, Campden Hill; Samuel John McIntire, 22, Bessborough Gardens, S.W.; William Allbon, 525, New Oxford Street; James Bell, Inland Revenue Laboratory, Somerset House; Arthur Raymond Betts, St. John's Park, Upper Holloway; Henry James Helm, The Laboratory, Somerset House; John Edmund Ingpen, 7, Putney Hill, Surrey; William Manning, 47, Clifton Road East; John Rogerson, St. Clair Cottage, St. John's Wood; George Naylor Stokor, Inland Revenue Laboratory, Somerset House; Arthur O'Brien Jones, The Shrubbery, Epsom, Surrey; John Martin, M.D., Cambridge House, Portsmouth; John Robinson Barnes, M.D., Ewell, Surrey; William Savill Kent, 56, Queen's Road, Notting Hill; William White, 3, Milner Square, Islington.

The following gentlemen were balloted for and duly elected Fellows of the Society:

Charles Coppock, Peter J. Gowlland, F.R.C.S., G. E. Legg Pearce, Henry Sugden Evans, and John Williams, as Honorary Fellow.

The PRESIDENT repeated the notice given at the former meeting respecting the opening of the Library.

A paper was read by JOHN GORHAM, M.R.C.S., &c., "On Some Peculiarities in the Distribution of Veins in Umbelliferæ." (See 'Trans.,' p. 14.)

Mr. JABEZ HOGG expressed surprise to find that a subject of apparently much interest, one most ably brought to the notice of the Society, had received so small an amount of attention from botanical writers. In a letter received from Dr. Maxwell Masters, that botanist offered a few remarks bearing on the question before them, which he would, with the permission of the president, read to the Society. Dr. Masters says:—"I have had some correspondence with Mr. Gorham about the matter (of the venation of the Umbelliferæ), and believe that the facts he has discovered have not been recorded before; at any rate, I have failed to find any notice of them up to the present time. The peculiarity in question is found in some other plants, and is not, I should imagine, of any very great physiological importance. In a group like the Umbelliferæ, where the species, and even the genera, are often so hard to discriminate, it is an excellent thing to get hold of facts like those discovered by Mr. Gorham, and I am very glad that he has taken the matter up, as I believe there are many similar things that have been overlooked, and which when collated will be very serviceable. Nature printing has done a good deal in this way. The publications of some Austrian botanists—Ettingohausen, Pokorny, and others—are worthy of attentive examination with reference to the venation of fossil, or of recent leaves."

Although quite true that some other plants have a similar kind of venation, Mr. Hogg believed it would be difficult to show that

a peculiar kind of venation runs through the whole of any other order than that of the Umbelliferæ, and that it runs through that order appeared to be a fact. After having carefully examined all the plants he, Mr. Hogg, could get together, they one and all confirmed the statements made by Mr. Gorham with regard to this group. It was quite true that some few attempts had been made to classify, or rather tabulate the venation of plants, but only a slight advance had been seen in this respect since the time of Dr. Grew, who, in his treatise on the "Anatomy of Plants," presented to the Royal Society in 1682, noticed the peculiarities of the structure of the fibres of the leaf, and published drawings showing something like an attempt at classification. As Mr. Gorham had shown his observations to Dr. Lindley it appeared strange that this eminent botanist had not made use of them to perfect his own classification of leaf venation, which, it must be acknowledged, was left in a very imperfect state. Now, however, Mr. Gorham proposes to reduce the question of leaf venation to practical utility, and in a large and important order of plants as that of the Umbelliferæ, which includes those yielding articles of diet, medicinal substances, and acro-narcotic poisons, it must become a subject of considerable value; and, although the facts brought to the notice of the Society may not at the present moment appear to have "any great physiological importance," it was, nevertheless, an excellent thing to get hold of a point in the perfect discrimination of a large genus, which, including as it does so many edible species, has very many more containing active poisonous principles, aromatic oils, gum-resins, &c. A morphological analogy had been shown to exist between the stem and the ribs or veins of the leaf; doubtless an analogy can be traced between the skeleton of the leaf and the skeleton of the branch in a number of points, as well as in the general resemblance between the ramifications of the plant and that of the venation of the leaf. On making a close examination under a power of fifty diameters of the leaves of the Umbelliferæ prepared by Mr. Gorham, Mr. Hogg observed that the analogy is borne out to a remarkable degree in the whole: and further that the analogy can be carried even to the venation of the petals and stamens. The umbels of the hemlock show this exceedingly well, and, no doubt, when others have been more closely examined, it will be found that the plant, the branches, the leaves, and flowers, present a morphology as uniform as it is remarkable.

Thanks were unanimously voted to Mr. Gorham for his paper.

The meeting was then made special.

Ellis J. Lobb, Esq., proposed the following resolutions:

"That every Fellow who shall be elected after the meeting on 11th December, 1867, shall, in addition to the entrance-fee of two guineas, pay a further sum of two guineas as his first annual subscription; and shall pay, so long as he continues a Fellow, an annual subscription of two guineas, which shall be due on the

1st of January in each year; and that Bye-law No. 6, Sect. 2, be altered in conformity with this resolution.

"Every Fellow who shall be elected after the meeting on the 11th of December, 1867, and who may desire to compound for his future annual subscriptions, may do so by a payment of twenty guineas, in addition to his entrance fee of two guineas; and that Bye-law, No. 7, Sect. 2, be altered in conformity with this resolution.

"And that Bye-laws 6 and 7, Sect. 2, be altered accordingly."

Major Owen seconded the resolutions, which, after a brief discussion, were put from the chair and carried.

December 11th, 1867.

James Glaisher, Esq., F.R.S., President, in the Chair.

The minutes of the previous meeting were read and confirmed.

The following presents were announced:

	Presented by
A Two-thirds Object-glass, with 50° angle of aperture	W. Wray, F.R.A.S.
An Investigating Tube	E. Richards,
Journal of the Society of Arts	The Society.
The Canadian Journal	Institute.
The Photographic Journal	The Society.
The Journal of the Linnean Society	Ditto.
Catalogue of the Surgical Section of the U.S. Army Medical Museum	The Surgeon-Gen. of U.S.
Daphnia Pulex, framed	Mr. T. Curties.
British Journal of Dental Science	The Society.
Land and Water (Weekly)	The Editor.
Life and Death in our Mines, by J. Hogg	The Author.
Anatomy of Urethra and Glans Penis, by J. Hogg	Ditto.
Vegetable Parasites of Human Skin, by J. Hogg	Ditto.
Developmental History of Infusorial and Animal Life, by J. Hogg	Ditto.
The Vinegar Eel, by J. Hogg	Ditto.
The Common Truffle, by J. Hogg	Ditto.
The Structure and Formation of Certain Nervous Centres, by Dr. Beale, F.R.S.	Ditto.
How to Work with the Microscope. Fourth Edition. By Dr. Beale	Ditto.
The Microscope in its Application to Practical Medicine. Third Edition, by Dr. Beale	Ditto.
Germinal Matter and the Contact Theory, by Dr. Morris	Ditto.
Natural History Review. Vol. 1	J. Hogg.

The following certificates were ordered for suspension:—Alfred James Puttick, 47, Leicester Square, W.C.: Hildebrand Ramsden, M.A., Cantab, Forest Rise, Walthamstow, Essex, N.E.

The twenty-eight gentlemen whose certificates were ordered to be suspended at the previous meeting were balloted for, and duly

elected Fellows of the Society. (For names see report of 13th November meeting).

Charles Stewart, Esq., M.R.C.S., F.L.S., &c., read a paper, illustrated by drawings, on the "Pedicellariæ of the Cidaridæ."

Mr. Jabez Hogg remarked on the importance of examining these appendages in the living animal. He also inquired whether Mr. Stewart had arrived at any conclusion as to the functions performed by pedicellariæ. He had witnessed their action in handing particles of food from one to another till they reached the mouth.

Mr. Stewart stated that he had examined the pedicellariæ of the living animals in many species, but had not had that advantage with respect to the Cidaridæ. From the position of the pedicellariæ, and the nature of the food of the Echinoderms to which they belonged, he did not think that the passing forward of particles of food to the mouth could be their chief or special function. The more these objects were studied in the different classes of animals furnished with them, the greater was the difficulty of assigning any special functions to them. One particular form, the Snake's Head, was found near the mouth. Other forms were extensively scattered, and were abundant near the anus in Cidaris. In Gonaster they were embedded in the thick calcareous surface layer with their two valves flush with the surface, so that they could not pass anything to the mouth. In Luidia stalked forms were found near the secondary spines.

Mr. Cook remarked that Agassiz had seen pedicellaria pass fæcal matter away from the anus.

H. J. Slack, Esq., F.G.S., Sec. R.M.S., read a paper on a "Ferment found in Red French Wine."

Mr. Jabez Hogg remarked on the value of reasearches into these organisms, which he regarded as agents of destruction. He considered M. Pasteur wrong in asserting that Bacteria were found in the butyric fermentation. They belonged to the lactic fermentation, which was an earlier stage.

The President then called upon Dr. Maddox to show a series of photographs to the Fellows.

Dr. Maddox said he had the pleasure of bringing before the notice of the Fellows of the Royal Microscopical Society a series of beautiful photomicrographs, which he had just received from the Army Medical Department, Washington, the labours of Drs. Woodward and Curtis, and trusted he might be able to convey to those gentlemen the thanks of the Society. He thought that the interest occasioned by a little "generous rivalry" might advance the subject in this country, where he was sorry to find existed so much negligence and apathy in this branch of science. Other countries were utilising its advantages, as France, America, &c., the latter being in advance of all. Some of these photomicrographs were exhibited as competitive photographic tests of various lenses, ranging from Powell and Lealand's $\frac{1}{30}$th, $\frac{1}{25}$th, and $\frac{1}{16}$th; Wales' $\frac{1}{8}$th and amplifier; Wales' $\frac{1}{35}$th immersion;

and Hartnack's No. 11 immersion lens; the object being the Podura scale, and the diameters 2100 and 756. In the foremost rank, in Dr. Maddox's opinion, stood Powell and Lealand's $\frac{1}{50}$th; then Wales' $\frac{1}{8}$th and amplifier; Wales' $\frac{1}{35}$th immersion; and Powell and Lealand's $\frac{1}{25}$th. Hartnack's did not give a good image photographically: but as Dr. Woodward, in a private letter to Dr. Maddox, remarked, this might have depended on the great want of coincidence of the visual and chemical rays, as it had to be "ruled out" considerably; but Dr. Maddox seemed to think it might be due to some trifling error in the centring, when the necessary chemical correction was made. Dr. Maddox said he believed the Podura scale had never yet, in this country, been photographed by a $\frac{1}{50}$th.

The series of twenty photomicrographs were greatly admired, especially a *Navicula rhomboides*, magnified more than 800 diameters, and taken with Wales' $\frac{1}{8}$th and amplifier.

The Fellows of the Society felt themselves highly gratified with the opportunity of examining the excellent results that had been placed before them.

Mr. Slack exhibited an ingenious lamp, made by Mr. Collins, and devised by Mr. Bockett. Mr. Highley had been the first, many years ago, to construct lamps so shaded that no light was allowed to escape except in the direction required for microscopic use. Mr. Bockett carried out the same idea by means of a parabolic silvered reflector and a dark screen. All the rays from this lamp were emitted straightforwards, in approximately parallel rays. Such a plan would effectually screen the eyes of an observer from extraneous light.

In reply to an inquiry, Mr. Collins said the parabolic reflector, without the lamp, would cost about 7*s.* 6*d.*

Mr. Browning remarked that, with such a reflector, it was highly necessary to correct the increased amount of the yellow ray, by using a blue chimney, as Mr. Bockett had done.

The following papers were read:

"On the Anatomical Differences observed in some Species of the Helices and Limaces," by Edwin T. Newton, Esq. (See 'Trans.,' p. 26.)

"On New Species of Microscopic Animals," by T. G. Tatem, Esq. (See 'Trans.,' p. 31.)

The usual vote of thanks was passed to their respective authors; and the President announced that at the next meeting, January 8th, Professor Rupert Jones, F.G.S., would read a paper "On Recent and Fossil Bivalved Entomostraca."

Errata.—The errors in reference to some of the figures named in the text in Dr. Maddox's paper on "Parasites of the Common Haddock," not corresponding with those in the plate, arises from all the illustrations sent not being engraved. It is necessary to erase references to figures on pp. 88, 90, and 92.

Quekett Microscopical Club.

September 27, 1867.

Mr. Arthur E. Durham, President, in the Chair.

Mr. Suffolk called attention to his most recent method of Dry Mounting.

Mr. J. Slade read a paper on "Snails' Teeth."

Dr. Maddox exhibited a collection of beautifully executed micro-photographs.

Two members were elected.

October 25, 1867.

The President in the Chair.

Mr. McIntire read a paper on "Chelifers," whichhe illustrated with drawings and numerous living specimens.

A paper by Mr. Charles Nicolson, M.A., B.Sc., on "Object-Glasses for the Microscope," was read.

Nine members were elected.

November 22, 1867.

The President in the Chair.

Mr. N. Burgess read the first portion of a paper on "The Wools of Commerce, Commercially and Microscopically Considered," and exhibited specimens of fine wool.

Mr. Bockett read a paper on a New Four-inch Object-Glass, by Ross.

Eight members were elected.

Dublin Microscopical Club.

18*th July*, 1867.

Dr. John Barker drew attention to a little epiphytic growth seated upon *Hormospora mutabilis*. This consisted of what one might most quickly convey an idea of by saying it represented a green "comma," the tail prolonged into an extremely slender stipes, reaching through the enveloping gelatine and standing upon the cell of the Hormospora. This, though presenting a considerable resemblance to the little "pin-like" production drawn attention to by Dr. Wright at the January meeting (probably identical with that alluded to by Dr. Wallich, as found upon *Streptonema trilobatum*, Wall. 'Ann. Nat. Hist.,' 1860), was quite a different thing. The filament bearing this very minute production in rather considerable numbers, was very singular-looking.

Mr. Archer was desirous to record the occurrence of a seemingly

rare little alga—*Dictyosphærium reniforme* (Bulnheim)—in a gathering lately made near Snowdon in North Wales, thus new to Britain. This he identified from the description and figure given in Rabenhorst's "Kryptogamen-Flora von Sachsen, &c.;" the figure, however, he thought, must have been drawn from a specimen, or rather group or family, somewhat distorted by the pressure of the covering-glass. The individual cells stand more regularly than is there depicted; they are naturally posed with their concave side, that is the sinus of the reniform cell, towards the centre of the group, and it is by the sinus that they are attached (by whatever means that may be) to the slender stipes. This stipes on each self-division of the cells at the summit (seemingly usually into four), becomes itself branched. The colour of the cells is a deep green, being densely filled with contents; reminding one considerably in this respect of those of Nephrocytium, in which plants the cells, likewise, are reniform, but not so distinctly so as in *Dictyosphærium reniforme*. So densely filled were the cells, that the two eye-like granules inferred in the figure given in Rabenhorst, did not at all present themselves in the Welsh specimens.

Mr. Archer showed Welsh and Irish specimens of a Cœlastrum, side by side, to show the absolute identity deducible from the marked character presented by the form. This form he would refer to *Cœlastrum microporum* (Al. Braun), as given in a note (but without a figure, and only briefly referred to, hardly described) in Braun's work ("Algarum unicellularium genera nova et minus cognita," page 70.). The group (cœnobium) is formed of rather large cells, externally globularly rounded, their margins, where in mutual contact, being straight, and leaving at the angles exceedingly minute, somewhat triangular interspaces, like very minute pores, leading into the central cavity, characteristic of the forms appertaining to this genus. Mr. Archer was able to present some specimens showing some of the cells with a young cœnobium within, formed from the contents of the parent cell; and these were seen to be quite like the parent in all respects as regards form of the cells and their mutual arrangement, differing only in size. Simultaneously therewith Mr. Archer was able to show another form of Cœlastrum, obtained on his late brief visit to Wales, which was not referable to either of the remaining forms as described by Nägeli, though perhaps showing most affinity with *Cœlastrum cubicum* (Näg.), but differing in each cell possessing but one process or tubercle-like appendage, not three. These likewise showed various conditions of growth of the young cœnobia within the mother-cells, from the earliest stage, the most minute of which showed the full character of the cells, each with the truncate tubercle-like process. It seems to differ quite from *C. sphericum* (Näg.) by the cells possessing this process and not being, like those of the species just referred to, conically rounded. For this form, Mr. Archer would propose the name *Cœlastrum cambricum*.

Mr. Crowe exhibited Welsh specimens of *Euastrum didelta* conjugated, showing the zygospore fully formed. This is very like that of *Euastrum oblongum*, only, as a matter of course, the species being itself considerably smaller, so too is the zygospore. Ralfs does not figure the zygospore of this species, but he describes it as spinous, the spines subulate. They do not, however, appear to be subulate but nearly cylindrical, and ending bluntly, and they are pellucid. Sometimes they are not posed vertically on the zygospore, but lean a little in different directions, and this is more especially the case in regard to those spines which project through the apertures of the empty halves of the parent-cells into their cavities; this circumstance, that is the divergence of the spines, seems as if it assisted in retaining the empty halves for some time attached.

By a curious coincidence, Mr. Archer too was able to present Irish specimens (from near Carrig Mountain) of the same species, *Euastrum didelta*, also conjugated, and showing in all respects characters similar to those of the examples exhibited by Mr. Crowe, gathered in Wales. Conjugated specimens of this species had also presented themselves to Mr. Archer during his late excursion to Wales. He was besides able to bring forward fine conjugated examples of *Euastrum oblongum* from the Co. Wicklow locality which had presented the zygospores of *Euastrum didelta* simultaneously exhibited,—an opportunity to see at one time the zygospores of these in themselves common forms, yet seemingly very rarely found conjugated, would not be without interest to the meeting.

Mr. Archer likewise exhibited a solitary "skeleton" brought from Wales, the only one which he had seen out of Ireland, and it was not living, of the Radiolarian Rhizopod he had previously found and exhibited living from "Callery-bog," near Bray (see minutes of April last). This creature seemed to him to come nearest to certain marine forms close to Heliosphæra amongst the Ethmosphærida (Häck.). From them, however, it differed in at least two points seemingly of importance, one of a negative, the other of a positive character. In the first place the so-called "yellow cells" were quite absent, and in the second place the hollow perforate globe, containing within it the sarcode actinophryan body, was supported, when living, upon a nearly pellucid stipes. At first Mr. Archer had overlooked this stipes, and even when, by the seeming constancy of its occurrence in the living specimens, it had caught attention, he had at first taken it for a fibre of some Leptothrix-like plant upon which the perforate shell had got accidentally, as it were, impaled. But by degrees it became evident that this hyaline thread-like structure, which bore aloft the perforate globe, was indeed part of the organisation of this curious and interesting form. Two points had been mentioned in which this creature presented a dissimilarity to the marine Radiolarians. A further more important negative character would be the absence of a "central capsule," if really there were

none; but still a fair proportion of the examples seen by him showed, within the perforate shell, an inner sharply-marked outline, possibly indicating that of an inner vesicle or membrane of some kind, which might represent the boundary of a very thin-walled or delicate central capsule, or at least correspond to that part of the typical organisation of a "Radiolarian" in Häckel's application of the term. But be that as it may, further examination of future specimens might, he hoped, throw some further light on this interesting form, seemingly connecting, be it more or less directly, the fresh-water Actinophryans with the marine Radiolaria. It was to be regretted, however, that this creature seems sufficiently rare—only a limited number of specimens had as yet turned up; they are exceedingly minute, and hence, in a great measure, only accidentally observed; therefore, the discovery of even a dead shell at the other side of the Channel might have some interest. This form had been brought before the Natural History Society by Mr. Archer at a recent meeting, under the name of *Podosphæra Haeckeliana*.

Mr. Tichborne exhibited a slide of Cryptopia. This is an alkaloid, occurring in opium in very minute quantities. It was lately discovered by Messrs. T. and H. Smith. It is difficult to crystallise well on a slide, but when produced makes a very pretty and characteristic polariscopic object. It forms hexagonal plates when crystallised from alcohol.

Read—the following extract from a letter addressed by Dr. Steele to Mr. Archer, secretary:—"Will you kindly mention at the Microscopical Club a very singular fact relative to the pollen of certain species of Primula which appears to me deserving of record. Most persons are aware that the flowers of the garden 'Polyanthus,' as well as those of the *Primula veris* and *P. vulgaris*, assume two forms, called by gardeners 'Pin-eyes' and 'Trim-eyes.' In the former the pistil reaches to the summit of the corolline tube, within which latter the anthers are sessile, about half way up. In the latter the pistil is relatively much shorter, the stigma reaching to about the middle of the tube, whilst the anthers are sessile at the mouth. The point to which I wish to direct the attention of observers, however, is, that the grains of the pollen of the former ('Pin-eyes') are about half the size of those of the latter ('Trim-eyes')."

15*th August*, 1867.

Rev. E. O'Meara exhibited some new and interesting diatoms; amongst which were a new species of Pleurosigma, remarkable for a row of bead-like dots running round the margins and along both sides of the median line, and a new Navicula. These were from the prolific Arran gathering; full descriptions and figures thereof will appear in this Journal.

Mr. Archer showed specimens of a Staurastrum which he considered identical with *Staurastrum apiculatum* (Bréb.); it was

longer in the spines than is figured in the illustrative plate accompanying M. de Brébisson's "Liste des Desmidiées observées en Basse-Normandie;" otherwise, however, agreeing therewith. These examples were accompanied by *St. dejectum* and *St. cuspidatum*, but always seemed quite distinguishable from both. This belongs, indeed, to a group of nearly allied forms, which, although they agreed essentially in outward characters, Mr. Archer ventured to think seemed always readily distinguishable; these are *Staurastrum apiculatum*, *St. dejectum*, *St. cuspidatum*, *St. Dickiei*, *St. O'Mearii*, *St. glabrum*.

Mr. Archer showed, new to Ireland, *Spirotænia minuta* (Thuret); this occurred near Carrig Mountain.

Dr. Frazer showed a sublimate of arsenious acid in fine crystals displaying interesting hemihedral forms.

Dr. Frazer likewise, on the part of Mr. Woodworth, exhibited specimens of human hair, now much sold in commerce for the manufacture of chignons, as "Marseilles hair." This had the hair-bulbs unremoved, and the enlargements had been imagined to indicate the presence of "Gregarinæ," but the microscope showed their true nature. An interesting inquiry results as to the origin of this kind of hair in commerce: it cannot be derived from living human beings, for its removal in quantity by epilating would be extremely painful, and, if obtained from the dead, it is probably removed when putrefaction has set in.

19*th September*, 1867.

Mr. Archer exhibited good recent specimens of the two little algæ lately recorded by him from Wales, then new to Britain, and now for the first time discovered in Ireland—*Dictyosphærium reniforme* (Bulnh.), and *Cosmocladium saxonicum* (de Bary). These specimens, which were from near Carrig Mountain, were quite identical in every respect with those from Wales. For the first record of these pretty little plants, see Club minutes of June and July last.

Rev. E. O'Meara showed a new species of Gephyria, of which figures and descriptions will hereafter appear in this Journal.

Mr. Archer also showed conjugated specimens, with the zygospores, of *Penium digitus* (Ehr.), Bréb., now recorded for the first time, commonly as this species presents itself. As, however, might almost be predicated, the zygospore is simply large and elliptic and smooth, being placed between the for some time persistent empty parent cells, which are kept apart from the zygospore by a conspicuous and thick gelatinous envelope.

Mr. Archer drew attention to a form of Arcella agreeing with *Arcella angulata* in surface characters of the test and in colour (no foreign bodies whatever entered into its composition), but differing in being of a quite globose form, with the exception of a small chord, as it were, being cut off at the aperture, in place of being hemispherical or rather more or less broadly campanulate. Thus,

in place of the flat surface bearing the (as usual in Arcella inverted) aperture being much dilated, as is the case in the ordinary form, by reason of its hemispherical or campanulate figure, in the present form the flat surface was much contracted by reason of its globular figure, hence the tests were prone to roll over and over. This was, moreover, a large form—though, not at any point expanded (like the ordinary form) out of the even globular outline—its diameter was considerably greater than that of *D. angulata*. In Dr. Wallich's plate of Difflugian forms ('Ann. Nat. Hist.') none, properly referable to Arcella, occur like this. It was not to be mistaken for the so-called *Arcella aculeata*, nor does Wallich's figure 22 (pl. xvi., loc. cit.), agree with the form now shown, either in form of aperture or in character of test, as that is evidently a built-up test. Pending the rediscovery of this form and further examination, Mr. Archer thought it would be not without advantage that, for sake of reference, it should possess a name, and he would venture therefore to call it, *ad interim*, *Arcella globosa*.

In the same gathering, Mr. Archer pointed out a couple of specimens of the rather common *Difflugia spiralis*, which seemed, as it were, to be turning a *Closterium lunula* to some advantageous account. They were closely attached thereto by the apertures of the tests, and seemed, as it were, to be sucking their prey; the contents of the Closterium were nearly completely effete and brown. A similar occurrence appears, indeed, not to be very uncommon.

Mr. Archer exhibited a form of Actinophrys, first drawn attention to by Dr. John Barker, and which he likewise had obtained himself in a gathering made from the same locality. This form was minute, colourless, pseudopodia very long and rather slender, but variable in thickness. It was, moreover, remarkable for two seeming specialities, one internal, the other external. The first consisted in the orbicular sarcode mass possessing two well-marked regions—a sharply-defined central body, which was surrounded by shallow margin of a lighter colour and of a "streaky" appearance, with an indefinite outline, whence emanated the pseudopodia. The central portion, occupying by far the greater proportion of the mass, was somewhat different in colour and much more dense in structure than the marginal portion, being of that granular appearance and somewhat bluish hue characteristic of the "nucleus" in Amœba.

This description calls to mind Stein's *Actinophrys oculata*, but, judging from his figures (repeated in 'Pritchard,' pl. xxiii, figs. 24, 25), they represent, indeed, quite a different thing. In that form the "nucleus," or eye-like central body giving the specific name, is very small, instead of occupying by far the greater portion of the mass of the body. The character alluded to, however, certainly indicates a resemblance, and in both this central body may be homologous, whatever be its actual nature or function. But the present form is still further unlike by reason of the

absence of the conspicuous series of marginal vacuoles and by the much more long and slender pseudopodia than depicted by Stein. So far as can be judged, too, from Carter's figures ('Ann. Nat. Hist.,' xv, pl. xii, fig. 1), his form does not seem to be identical with that of Stein, nor with the present.

Having proceeded so far with the description and exhibition of this form, fearing that a certain amount of coincidence of its characters with those of the form Mr. Archer had brought forward before the Club in April last (see minutes of that date) might lead some to suppose they were identical, he again presented some good examples of the latter. This latter is much more frequently met with in our moor pools (near Bray, &c.), than is the form which was now particularly drawn attention to. A very slight inspection showed it was indeed quite a distinct-looking thing, both in colour and in structure of body and character of pseudopodia.

But if the Actinophrys now for the first time exhibited to the Club appeared *à priori* to be a different thing from *Actinophrys oculata* in the points alluded to, it seemed (in a measure) to agree with it in that circumstance which had been alluded to as the second or external speciality—and that was, their occurring occasionally consociated into elegantly and definitely arranged groups; this union being caused, however, not by a complete confluence of the bodies, but merely by the mutual fusion of a number of the pseudopodia, along which certain granules could be occasionally seen to flow from one animal to another. These composite groups did not contain many individuals, six being the greatest number observed; and these were mostly arranged in two alternating triangles, or four arranged in two alternate pairs, but three or two individuals only were sometimes joined. This combination by means of the fusion of the pseudopodia did not, however, extend to the bodies, like that of *A. oculata*.

A suggestion then presents itself, looking on these groups in a perhaps superficial way—a suggestion, indeed, which future examination of this animal, when it may be again encountered by observers, may refute. May, indeed, the large central body with its sharply-defined outline, almost looking like a definite wall or envelope, be considered at all homologous with the "central capsule" of such marine Radiolarian forms as Collozoum? Nor would the absence of spicules militate against the correctness of this idea, for Collozoum is without them, and the central capsules of certain of the Radiolaria are described as very delicate and thin. The constituent animalcules of a group seem to cohere much in the same kind of way as do those of the compound marine forms; in the form now exhibited this union does not seem to represent any "conjugation," but rather a combination of individuals carrying on a community of life, but at the same time, as the free individuals upon the slide proved, quite capable of becoming disengaged and living solitary. Compare it, too, with Mr. Archer's animal, *Raphidiophrys viridis* (referred to in Club

minutes of December, 1866), which rhizopod indicates a kind of compound life, not only by the union of numerous hollow globular clusters of granules pointing to so many centres, as it were, of a kind of secondary individuality, but these seemingly compound clusters are themselves sometimes combined, in certain limited numbers, into larger groups by the union of the pseudopodia. Raphidiophrys, too, is furnished with spicules—as marked as *Sphærozoum italicum* (Häck.)—but it is destitute of "yellow cells." Equally, however, with Raphidiophrys, as well as the Radiolarian with a perforate shell twice brought before the Club by Mr. Archer (from Ireland and Wales: see minutes of April and July), which latter indicated even stronger affinity to the marine types, the present Actinophryan likewise showed nothing comparable to the "yellow cells;" and hence the perhaps vague idea here thrown out touching the principal subject of the present exhibition may be of little value. Yet, though the similarity may be regarded as but superficial and the affinity be thought remote, still one could not look at Häckel's figures nor his statements without being at least in a measure struck by the resemblance.

The allusion to the perforate Radiolarian suggested to Mr. Archer to inform the Club that identically the same animal as his had been brought forward in May last, by Cienkowski, in Schultze's 'Archiv für mikroskopische Anatomie' (Bd. iii, Heft iii, 1867, p. 311, t. xviii), which Mr. Archer had only just had an opportunity of seeing. Cienkowski had described it under the name of *Clathrulina elegans*. There could not be any doubt whatever that the animal Mr. Archer had mentioned (and which he had described at the June meeting of the Natural History Society of Dublin, but which he would now withdraw) was perfectly identical with the newly-described Radiolarian, *Clathrulina elegans* (Cienkowski). Having, however, seen Cienkowski's paper and figures, it now seemed probable to Mr. Archer that he must have mistaken the "cyst" referred to by that author for the representative of the "central capsule" (see pl. xviii, fig. 7, loc. cit.). Of these sharply-defined bodies (probably Cienskowski's cysts) only one had ever presented itself in any single individual of the Irish specimens as yet, hence (not having been so fortunate as to see any further development) the mistake might be considered the more excusable, as, moreover, a by no means indefinite internal contour was to be seen even in examples with extended pseudopodia.

It would at least be not without its interest, however, to have recorded the occurrence of this novel form in the British Islands, especially as only two other localities are given for it (in Russia and in Germany); and there as here, as Cienskowski states, it "occurs very sparingly and rarely." Its minuteness, however, may be partly the cause of its not having been previously detected in other localities. As indicating the likelihood of this, Mr. Archer thought it might be interesting to add another Irish locality to that of Callery Bog, and that was in Co. Tipperary, in a gathering

from whence he had found a single dead shell or skeleton—enough, however, to establish its occurrence.

Although without the experience justifying him to speak at all definitely on Rotatoria, Mr. Archer ventured to bring forward as new a very handsome free-swimming form belonging to the Family Brachionœa, and seemingly appertaining to Perty's genus Polychætus, a genus disallowed by Leydig, as he imagined Perty's *Polychætus subquadratus* to represent some Crustaceau. Yet the present form (obtained both from Carrig and Callery districts) seemed to fit here, and it at least was assuredly a rotatorian. However, the character of the genus (if this animal be correctly referred as congeneric with Perty's) must be slightly modified, inasmuch as the present form had a carapace toothed not only at the four corners of its subquadrate outline, but was minutely toothed all round the margin—more strongly, however, at the upper outer angles, and more strongly still at the posterior angles, which were each terminated by a long conspicuous spine accompanied by two intermediate. Instead of from ten to twelve long spines on the flat surface, as in *P. subquadratus*, there were four only, and these of considerable length. When the animal turned so as to present a side view, these spines stood forth, long and conspicuous, as sword-like weapons. At a distance from each lateral margin of about one-fourth of the width of the carapace, and seemingly on both surfaces, there was presented a line or series of spines, similar to those fringing the margin and running parallel thereto and taking a nearly similar curve, from the anterior to the posterior end of the carapace. All the intervening portion of the surface of the carapace was thickly covered with very minute tooth-like acute spines, rather irregularly scattered, and giving it a rough appearance. On the "tail" (of two joints) were also two rather long acute spines, and there were two spinous "toes." The eye was single, large and red, and the head *whiskered* on each side by a row of minute, very acute spines, very prominent when the animal's head and neck became fully protruded from the carapace—in fact then standing out like a comb on each side—the teeth at the middle being the longest, and gradually diminishing above and below. There was a frontal continuous tuft of cilia, not conveying the idea of a "rotatory" motion, but waved with considerable energy. The motion of this pretty creature was not very rapid or active; it seemed rather to glide, or in a measure gently flutter about. The thickness of the body was comparatively pretty considerable, and the viscera appeared very opaque. It would seem, hence, difficult to portray the internal organisation, and Mr. Archer had much to regret that, partly from this cause and partly from his want of experience in these animals, he was unable to throw any light on the internal characters. In the meantime, however, he ventured to think there could be no doubt but that this was an undescribed rotatorian, and he would suggest for this elegant creature the name of *Polychætus spinulosus*.

ORIGINAL COMMUNICATIONS.

On New Species *of* Diatomaceæ, *being a* Reply *to* Mr. Kitton's Remarks. By the Rev. E. O'Meara.

In reply to Mr. Kitton's animadversions on my two papers recently published in the 'Microscopical Journal,' I venture to make a few remarks. To resent the temper of his criticisms could subserve no useful purpose, and therefore I refer to it merely to express my sincere regret that the intrinsic value of the remarks should have been depreciated by the tone in which they have been expressed. It is not unnecessary to say that I have been for very many years devoted to the study of the Diatomaceæ of Ireland, and have carefully examined many thousands of gatherings made by me, in all parts of the country and at all seasons, and have never attempted to publish any forms as new until the Arran dredgings of Dr. E. Percival Wright were placed by him in my hands. I do not make this statement of facts for the purpose of arrogating to myself a right to speak on the subject with an authority equal to that which Mr. Kitton has assumed, but of vindicating myself from the charge of being a novice in the matter, and of being affected with the disease usually known as the *cacoethes scribendi*, which his observations not very graciously suggest.

How inapplicable are some of Mr. Kitton's observations on dredgings to the forms found by me in the dredgings from Arran, the following letter from Dr. E. P. Wright sufficiently proves:

"My dear O'Meara,—The collection of Diatoms from Arran was made by me during the autumn of 1866, under the following circumstances. In the harbour of the larger island, and near the little island called Straw Island, I found large meadows of several species of brown Algæ, such as *Desmarestea ligulata, Cordaria flagelliformis*, &c. On one or two days in which the wind was too strong to admit of dredging in the open bay, I made a large collection of these

different Algæ. The dredge was thrown into water of some seven or eight fathoms' depth at low water, and dredged along into water of such a depth that the boat would just float. I brought the material thus gathered to the hotel for the purpose of searching it over for minute Crustacea, Annelids, &c., &c.; and being struck on several occasions, when examining it with a low power ($1\frac{1}{2}$ objective) of the microscope for Foraminifera, with the number of Diatoms present, I dried the weed in the sun, and then shook off all or the greater part of the fine particles adherent to it. This siliceous dust I gave to you. I also brought a small basketful of the weed with me to Dublin, and having steeped it for some hours in about two quarts of distilled water, I filtered it gradually through a muslin strainer, and gave you a bottleful of finely divided mud that passed through. One very small stream of fresh water flowed into this bay, a fact that may account for the presence of fresh-water forms in the Arran gathering. I feel very certain that all the Diatoms were attached to the Algæ, and were not taken on the ground, as, owing to the quantity of sea-weed, the dredge did not scrape the bottom.—Ever very sincerely yours, Edw. Percival Wright, Lect. on Zoology Dub. University."

It will, doubtless, seem strange to most readers that Mr. Kitton should have ventured to pronounce his judgment on the forms referred to without having had an opportunity of examining them. Had he vouchsafed to ask, I would have gladly supplied him with some of the material, and then he would have been in a better position to form a judgment, and more weight would attach to his opinion.

I cannot forbear to express the surprise I experienced on the perusal of his paper to find that one so sharp to detect what he regards as the mistakes of others, and so forward to expose them, should himself have been guilty of such inaccuracies as the following—inaccuracies I cannot attribute to any other cause than a hasty and superficial perusal of the papers he undertook to criticise.

"*Navicula pellucida*, O'M., fig. 2, is a state of *Navicula Pandura* of De Brébisson." In my paper, *N. pellucida* is fig. 3, and to it his observations are utterly inapplicable. I suppose he intended to refer to *N. denticulata*, fig. 2, which does exhibit some general resemblance to *N. Pandura*, though at the same time the difference is so marked and so constant, as not only to justify but as I think to require a distinct name.

Again, "*Raphoneis liburnica*, O'M., fig. 8." In my paper this form is referred to in the following terms:—*Raphoneis*

liburnica, var., fig. 8. By the word he has omitted, and the letters he has unwarrantably introduced, Mr. Kitton charges me with claiming this designation as my own, whereas I attributed it to Grunow, and represented the form described by me merely as a variety of *Raphoneis liburnica* of that distinguished author.

Again, at page 16, we read, "*Cocconeis divergens*, fig. 5, may be the same," &c. Although no form so named occurs in my papers, that to which I suppose he intended to refer is *Cocconeis clavigera*, which is so dissimilar in all respects to *C. costata* of W. Gregory, as well as to *Raphoneis Archeri*, it is difficult to comprehend how they could be confounded.

These inaccuracies, however, although evidences of carelessness, do not materially affect the judgment pronounced, but the same cannot be said regarding the following mistake.

Page 14, "In the following observations I have assumed the amplification in the first paper to be the same as in the second, viz., 600 diameters." Now, the amplification in the second paper is not invariably 600 diameters, as the words referred to would lead the reader to suppose. In some instances, as indicated in the table, it is 800 diameters; and in the description of the figures, which accompanied the first paper, the amplification is plainly stated to be 400 diameters, and not 600, as was assumed.

As regards the forms in my papers which have happily escaped animadversion, it is to be presumed they are exempt from objection; and if so, enough remains to attach considerable interest and value to the Arran gatherings.

But as regards the forms which have provoked the censure of Mr. Kitton, what is his judgment, and by what process has he reached it?

"The following forms described in Rev. E. O'Meara's papers may, I think, be referred to previously described species." It is difficult to understand how his remarks on *Pinnularia divaricata* are reconcileable with this form of expression. They are to this effect. "*Pinnularia divaricata*, O'M., fig. 7, if correctly figured and described, can neither be a Pinnularia nor Navicula, as none of these genera have forked striæ or costæ." On the assumption, then, that the figure and description are correct, and I can assure him that they are, this form, in Mr. Kitton's opinion, must be separated from these genera—must, in fact, be assigned to a *new genus*. How incongruous the opinion thus expressed with the previous statement, so far as the form in question is concerned, "the following forms may, I think, be referred to previously described *species*."

The decision Mr. Kitton has pronounced is expressed with so much doubtfulness, and so much that is conjectural, as might reasonably, in my opinion, have suggested the propriety of dealing with the subject in a gentler tone. But to give colour to the verdict as it stands it is necessary to supply the deficiency of facts from the suggestions of imagination. It is necessary to presume that the forms are imperfectly figured and described—that I am not capable of discriminating between a central nodule and a small grain of quartz that chance has thrown in the position—that the sculpture in certain portions of the valve has been obliterated by abrasion—that a certain peculiarity of structure is nothing more than an abnormal marginal development. How far such presumptions are warrantable, and what weight is due to a judgment reached by such a process, I leave to others to decide.

Some of Mr. Kitton's remarks I freely acknowledge, on mature consideration of them, appear not without some reason to support them, though many others, as I think, afford ample justification to doubt their accuracy.

Having carefully re-examined my specimens of *Navicula Wrightii*, I have no hesitation in expressing my conviction that the absence of sculpture in the spaces on either side of the median line is perfectly normal, not a trace of striæ is to be found throughout their entire length, while on the marginal portion of the valve the striæ are in all cases perfectly distinct, and exhibit no traces of the valve having been subjected to the process of abrasion. The general resemblance, indeed, between *Navicular clavata*, *N. Hennedyi*, and *N. Wrightii* is so obvious that I consider future systematisers would be warranted in so modifying the descriptions of these forms as to include them under one denomination, but so long as the two former are regarded by the authorities as distinct from each other the last has a right to be regarded as distinct from both.

It is not improbable that *Raphoneis Jonesii* and *Raphoneis Moorii* might be advantageously classed with *Cocconeis scutellum*, to which they bear in some respects a strong family resemblance, but a careful inspection of the valve, and, as I think, a careful consideration of the figures and descriptions, would convince that Mr. Kitton's opinion that they belong to one and the same species is untenable. The sculpture in the two forms exhibits a much greater diversity of structure than is considered sufficient in other forms to mark diversity of species. The figures, unhappily, were printed off without being submitted to me for correction, but to obviate the mistake which mere inspection of the figures might lead to, I

added to my original descriptions of the forms such further particulars as I considered necessary to convey a clear conception of the difference between them so obvious to the observer. If these forms be referred to *Cocconeis scutellum*, they differ from any I have seen in nature, or in the figures of such authors as have come under my notice, and seem entitled to be regarded as undescribed and distinct varieties.

On this subject I may remark further that Mr. Kitton appears to confound what I call the border in *Raphoneis Jonesii* with the cingulum or hoop which unites the two valves of the frustule; the latter is separable, as he observes, but the former, as an essential portion of the valve, is not altogether an insignificant character of the structure.

Before Mr. Kitton's remarks came under my notice, the valuable German publication 'Hedwigia' had made me aware that the specific name of gracilis had been previously applied to a form of Surriella, and I had determined on the first occasion that offered to correct my mistake, and give the name Gracillima instead of Gracilis. Grunow's figure was familiar to me, and I know not how the name escaped my notice when examining his list, as well as others, to ascertain whether the name I had selected had been anticipated. Mr. Kitton's remarks on Surirella are at variance with the views of the highest published authorities on the subject; Dr. Gregory and Dr. Greville, as he frankly acknowledges, differ from him. Pritchard and Grunow in their classification of the genus Surirella make use of those differences in the outline of the valve and the structure of the costæ, which Mr. Kitton considers of little value. *Surirella lata* and *S. fastuosa* are regarded by these authors, as well as by Smyth, as distinct species. Both the species I have described occur frequently in the Arran dredgings; the forms belonging to them respectively differ little in outline, and invariably exhibit the peculiarities in the shape and arrangement of the costæ which I have noticed in my descriptions. Supported by the example of these authors, so illustrious in this department of science, I considered myself—and still consider myself—justifiable in giving distinct names to these forms of Surirella.

In addition to the characters already referred to, I avail myself of the present opportunity to notice a peculiarity in the general structure of these forms, which strengthens my reasons for separating them from *S. fastuosa*. On the side view the valves in these species are flat, whereas in *S. fastuosa* the centre is deeply depressed, and in the front view, although

the valves are larger than those of *S. fastuosa*, their breadth is considerably less.

When Mr. Kitton suggested that *Pinnularia constricta* may be "possibly a form of *Navicula truncata*, a very variable species both in size and costæ," I presume he referred to a species so named in Dr. Donkin's interesting paper published in the 'Mic. Journal,' Jan., 1861. The side view of Dr. Donkin's form is not described, and from a careful comparison of my form with his figure I considered they were distinct. In any case the specific name of Truncata for that form must be dropped, because Kützing, in his 'Bacillarien oder Diatomeen,' taf. iii, fig. 34, and taf. v, fig. 4, has figured and described a form with this specific name which bears no resemblance to *Pinnularia constricta*.

But further, some of Mr. Kitton's conjectures seem to me untenable, except on principles which would have the effect of involving the classification of the Diatoms in utter confusion; for if *Navicula denticulata* is to be confounded with *N. pandura*—*N. amphoroides* with *Amphora salina* (in which case I must assure Mr. Kitton that the suggestion so ungraciously offered in the "query," is not the nodule a small grain of quartz?" is the baseless figment of his fancy)—*Raphoneis Archeri* with *Cocconeis costata* or *C. clavigera*—*Eupodiscus excentricus* with *Coscinodiscus minor*—the hope of distinguishing species with any reasonable certainty must be abandoned in despair.

In the case of *Raphoneis Archeri* there is nothing to sustain Mr. Kitton's conjecture that the puncta have been abraded. Since the paper describing it was published, the same form has been found by me in considerable abundance on seaweeds from the Falkland Islands and from Kerguelen's Land. In the structure of *Eupodiscus excentricus* there is not even a remote resemblance to that of *Coscinodiscus minor*. Had Mr. Kitton identified it with *Coscinodiscus excentricus*, he would have had some reason to support his view, for in this form the sculpture is similar to that of *Coscinodiscus excentricus*, a fact which suggested the name. This form frequently occurred in the dredgings, and invariably exhibited the peculiarities noticed—a smooth submarginal border, and distinct processes on the secondary surface. Even suppose it be conceded that the former is, as Mr. Kitton suggests, "an abnormal marginal development," he has not accounted for the latter, namely, the processes which seem to remove the form from the genus Coscinodiscus, as defined by the latest published authorities on the subject.

In common with many who have devoted their attention to the study of the Diatoms, I entertain the opinion that the system of classification requires and is capable of much improvement. Generic characters might be more satisfactorily defined than they are at present, and more comprehensive specific descriptions might be adopted; and by this means the existing nomenclature might be advantageously reduced. I hope and expect that the promised work of Herr Th. Eulenstein, whose extensive experience and sober judgment eminently qualify him for the task, shall soon supply the desideratum, and place the classification of the Diatoms on a basis more simple and more satisfactory than the present.

But Mr. Kitton, as it appears to me, would apply the knife before the patient is prepared for the operation. Deep-seated and long-standing maladies may be allayed, perhaps, by superficial applications, but will certainly return unless the remedy be of such a nature as to reach the seat of the disease. That our department of science has been embarrassed by an excessive nomenclature must be obvious to every experienced observer. The evil is traceable in some considerable degree to the fact that the descriptions of species are not as comprehensive as they might be. When, therefore, the student, in the course of his investigations, discovers forms similar to some he finds described, but at the same time exhibiting constantly some peculiarities not noticed in the description, he has no alternative but that of either adopting a defective description or of marking the peculiarities he has noticed by some distinctive name. By the adoption of the former course he relieves his memory at the cost of exactness; by choosing the latter he secures precision, though it be at the expense of a tax upon his memory. This latter method I regard as the more scientific, and that which will eventually prove more efficacious to remedy the evil and obviate its recurrence for the future.

Impressed with this conviction, and with this object in view, I consider the proper course for the student is to adopt the existing descriptions of species, to note carefully all constantly occurring deviations, and to mark them by a distinctive name. By such means his labours will increase the materials for the construction of a more satisfactory system of classification; and if this result be ultimately attained, they whose observations have been conducted on this principle will be amply consoled for the animadversions their method may have occasionally provoked.

On certain Butterfly Scales *characteristic of* Sex. By T. W. Wonfor, Hon. Sec.

(Read before the Members of the Brighton and Sussex Natural History Society, Nov. 1867.)

Nearly every one who has worked with the microscope and turned his attention to the scales of insects (especially the Butterfly tribe) has perhaps been struck with the great variety of form to be found not only in different butterflies, but on the under and upper side of the wings of the same insect. If, too, an attempt has been made to find in the "whites" or "blues" the scales described in all works on the Microscope, as found on certain members of each group, he has undoubtedly met with disappointment, especially if he has looked where our standard works tell us they are to be found. Thus, in the case of the azure blue (*Polyommatus argiolus*), we meet with instructions tending to mislead; thus in the 'Micrographic Dictionary,' under "Polyommatus," p. 564, we read—"The scales upon the *under* surface of the wings of *P. argiolus* and *P. argus* have been proposed as test objects. They are of two kinds—one resembling in structure the ordinary scales of insects, the other of a battledore form." Again, under the head of "Pontia," p. 571:—"The form and structure of certain scales existing upon the *under* side of the male is curious." Now, any inquirer looking, in either case, in the situations named, will undoubtedly not find them, for the simple reason that these particular scales are never found on the *under* side.

It was in endeavouring to work out, in 1864, these and a kindred scale that I hit upon certain facts, which perhaps may have been discovered before; but as I have not been able to find any record of them, I thought the subject sufficiently interesting to bring before the microscopic world. One fact has reference to the *position* of the battledore scales; the other tends to the belief that they, and certain other forms to be described, are, in the three families of the Polyommatus, Pontia (or Pieris), and Hipparchia, *characteristic marks* of sex—at least I have proved such to be the case, as far as I have been able to obtain specimens for observation. In the "blues" proper there is a marked dissimilarity in the colour of the sexes; for, while the males are of various shades of blue, answering to the names azure, mazarine, &c., the females are of a brownish hue, spotted or dashed with bluish scales. Any person seeing them together for the first time

would consider the brown-coloured ones a distinct species; in fact, one often hears the remark made, "Are you sure they are blues?" Now, this difference of colour may have led to the ordinary error that the "battledore" is found on the "blues," for undoubtedly it is found only on the *blue-coloured males*. Curiously enough these "battledore" scales are placed in rows, under the ordinary scales, and at the intervals, as in fig. 10; so that, if the ordinary scales be removed from the upper portion of the wings, the "battledores" will be found arranged in rows, plentifully on the fore wings, but more sparsely on the hinder wings. I have examined *P. alexis*, Pl. I, fig. 1 (common blue); *P. argiolus*, fig. 2 (azure blue); *P. acis*, fig. 3 (mazarine blue); *P. corydon*, fig. 4 (Chalk-Hill blue); *P. adonis*, fig. 5 (Clifden blue); *P. argus*, fig. 6 (silver-studded blue); *P. arion*, fig. 7 (large blue); *P. alsus*, fig. 8 (Bedford, or little blue); and *P. bœtica*, fig. 9 (tailed, or Brighton blue); and in each case found them only on the upper surface of the wings of the males, and arranged, as before mentioned, in rows; in the case of unbattered and well-preserved insects in about equal proportions with ordinary scales. As might, perhaps, be expected, the battledores differ in size, shape, length of blade or handle, according to the particular species, and, perhaps, might be used as adjuncts in determining varieties sometimes met with. I am anxious to obtain an hermaphrodite form of the common blue *P. alexis*, as figured in 'Humphrey and Westwood's Butterflies,' in which one side is of the character of the ordinary blue male, the other of the brownish female.

Thus far with the "blues" my observations have proved that the "battledore" is characteristic of sex. I had a confirmation of this in the case of the "tailed blue." A collector had supplied me with portions of wings of one of these insects, but was uncertain whether from males or females. I examined all without finding any trace of a battledore; but the next day, obtaining from him an undoubted male, I found at once any number of battledores.

By reference to figs. 1—9, all drawn to the same scale (240 diam.), it will be seen how great a difference exists in form and size; thus figs. 4 and 7 are from the Chalk-Hill and large blue respectively, the two largest British; while fig. 8 is from not only the smallest blue, but our smallest butterfly.

To turn now to the whites, or genus Pontia or Pieris. I had found the two forms of "tasseled" scales, or those having a brush-like termination, figured in the 'Micrographic Dictionary,' on males of the large and small cabbage

white (*Pontia* or *Pieris brassicæ*, fig. 11, and *P. rapæ*, fig. 13), and argued that something similar ought to be found on other members of the same family. The first I tried was the green-veined *P. napi* (fig. 14). This gave a scale differing slightly from the small white, but somewhat broader and more triangular. The orange tip (*P. cardimines*, fig. 12) for a long time puzzled me, as my specimens were battered; but having caught insects in good condition, I found the short brush-like scale differing considerably from the other whites. On the Bath white (*Mancipium* or *Pieris daplidice*, fig. 15) I found a scale half-way between the orange tip and small white, that is, the ribbon-like form of the one and triangular brush of the other. All these whites differ also in their modes of attachment to the wing, the stalk being of a different construction from that of the ordinary scale or the battledore of the blues. Though the arrangement of the scales is in rows and at intervals, as in the battledores, they are not so readily made out *in situ*, but from their greater length present the appearance of hairs.

In the case of the Hipparchia family, I happened while at Dorking this summer toco me across plenty of the *H. semele*, fig. 18 (grayling), and conceived, as there was a well-known scale, brush-like and tapering after the manner of the large white, but differing from it in the markings on the ribbon-like portion, on the *H. jariva*, fig. 17 (meadow brown), that there might be something on the grayling. At first I was disappointed, until I discovered my specimens were all females. The next morning I caught some males, when a decidedly shaving-brush like scale was the result. Pursuing the same plan with all the Hipparchiæ I could procure, I have obtained the following results: distinctive scales, differing from each other in *H. tithonus* (large heath), fig. 16; *H. pamphilus* (small heath), fig. 19; *H. ægeria* (wood argus), fig. 21; and *H. magæra* (wall argus), fig. 20. In all these cases the brush-like scales are plentifully arranged in rows, and project considerably beyond the ordinary scales. I have not yet had the opportunity of pursuing my investigations among the other families;* but as far as I have gone, I think it is clear there are in the three families of Polyommatus, Pieris or Pontia, and Hipparchia, forms of scales found only on the males. In addition to this, the ordinary scales in males and females are the same, so that these peculiar scales may be taken to be characteristic of sex. What purpose, if any, they serve, I cannot conceive. They seem to me to have their

* I have since found characteristic scales on members of the Argynnidæ (Fritillaries).

analogues in the beard of man, the mane of the lion, and the plumage of some birds.

In obtaining the scales, I have found the best way to examine a wing is to lay it on a clean slide, place another upon it, and apply a moderate amount of pressure. Upon separating the slips, plenty of scales from either side, in their relative positions, will be found on the glass slides. If required to mount, a ring of varnish may be run round, and when nearly set, a glass cover being laid on the slide, it requires only a finishing coat when dry to make it ready for the cabinet.

Note.—My observations have been confirmed by the examination of many tropical and Continental species of the above-mentioned families; and since January of this year (1868), I have become aware that Mr. J. Watson, of Manchester, has read papers on the "Plumules," before the Manchester Literary and Philosophical Society, and is engaged, as I learn by correspondence, in publishing a work on that subject, to be illustrated by 600 figures.

REVIEWS.

The Microscope, its History, Construction, and Application. By Jabez Hogg, F.L.S., Sec. R.M.S. Sixth Edition. London: George Routledge and Sons.

It is quite needless for us to do more than to announce this new edition of Mr. Hogg's work. A book that has gone through six editions, each edition consisting of ten thousand copies, has little need of any recommendation from the reviewer, whilst its enormous sale is its own best advertisement. We may, however, say a word or two on the reasons of the success of Mr. Hogg's book. In the first place, it is a very complete history of all that has been done with the microscope, and may be used, through the aid of its good index, as a dictionary on all matters connected with the instrument. In this new edition, also, Mr. Hogg has brought his information up to the present time, and we are especially flattered to see how extensively he has used our own pages to bring up his book to the knowledge of his day. It has always been our effort in the 'Journal,' which accompanies the 'Transactions of the Royal Microscopical Society,' to supplement these important labours of our own great school of English microscopists, by giving an account of everything that is being done in other countries, and in our local English Societies. We are glad to find our labours extensively acknowledged, and it is gratifying to find them contributing to so valuable a volume as that by Mr. Hogg. In the next place, Mr. Hogg's volume is really capitally illustrated. It contains upwards of three hundred and fifty wood engravings, and the present edition contains eight beautiful coloured plates, executed by Tuffen West. The name of Mr. West is a sufficient guarantee for the accuracy and value of these illustrations. We have never seen more successful work turned out even by Mr. West himself. In addition to these great recommendations, the price of this volume is so small that nothing but its amazing sale could

have enabled its enterprising publishers to have offered the volume for so small a sum. We most cordially recommend this sixth edition of Mr. Hogg's book.

Histological Demonstrations for the Use of the Medical and Veterinary Professions. By GEORGE HARLEY, M.D., F.R.S., and GEORGE T. BROWN, M.R.C.V.S. London: Longmans.

WE ought to have noticed this book earlier, but have put it aside from quarter to quarter in the hope of being able to write such a notice of its contents as its value and importance demands. Press of other matter has, however, prevented this, and we now feel that we ought not to allow another issue to pass without introducing it to our readers. For many years Dr. Harley has been in the habit of giving a course of physiological demonstrations at University College. "The observation of the facility with which objects were prepared for examination in the presence of the class, and the readiness with which the directions of the demonstrator were comprehended and carried into effect by the students," suggested to Mr. Brown "the possibility of describing in an intelligible manner the method of instruction which was so successful in practice." The volume thus commenced by the pupil has been superintended by the master, and a very valuable aid to anatomical research by the use of the microscope has been the result.

There is no doubt that the microscope is popularly regarded as a very amusing instrument, and we wish we could divest our minds of the feeling that a great many microscopical societies regard it as anything more, but the medical student should remember that it is as much his duty to use the microscope as an instrument of observation as the stethoscope, the laryngoscope, or any other instrument that modern science has put into his hand. Examining boards may not think so, and some medical examiners would perhaps be sorely puzzled to make the simplest microscopic demonstration, but, nevertheless, life and death may hang on the ability of a medical man to make a microscopic diagnosis, and woe to the man, however many diplomas he may possess, who goes through life with "knowledge through one entrance quite shut out."

The medical student will find this volume a thorough

introduction to both physiological and morbid histology. The introductory chapters are devoted to a short account of the best instruments and apparatus to be employed for histological purposes. Subsequently each healthy tissue is taken up and examined. After this, diseased tissues are considered, and all the principal points in microscopic investigation which ought to be mastered by the medical student are taken up. The descriptions of tissues and morbid products are accompanied with an extensive series of illustrations on wood, some of which are copied from Kölliker's great work, others are taken from the 'Cyclopædia of Anatomy,' whilst a large number are original. This work will not only be found useful to the medical student, but the medical practitioner whose early education was conducted in a pre-microscopic era will find in it a most convenient manual for teaching him what are the practical points to which the microscope may be applied in the practice of medicine.

A Handy Book to the Collection of Algæ, Fungi, Lichens, Mosses, Diatoms, and Desmids. By JOHANN NAVE. Translated by the Rev. W. W. SPICER, M.A., F.R.M.S. London: Hardwicke.

ALTHOUGH this little book is devoted to the subject of the collection and preparation of all the lower Cryptogamia, it will have a peculiar interest to the microscopist on account of the especial directions given for the collection and preservation of the microscopic forms of plants. A large proportion of the work is devoted to the fresh-water Confervæ, the Diatomaceæ, and Desmidiaceæ, and there are few collectors, however practised, who will not find valuable hints in it. To the young collector it will prove a storehouse of information, and contribute greatly to the success of his researches. The work is accompanied by a series of plates in wood, which will materially assist the beginner in working at the microscopic algæ. It has been translated with great care by the Rev. W. Spicer, and no one interested in the lower forms of plants can fail to receive instruction and interest from its unpretending pages.

QUARTERLY CHRONICLE OF MICROSCOPICAL SCIENCE.

Siebold and Kolliker's Zeitschrift. f. wissensch Zoologie.—Bd. xviii, heft i.

I. *Studies on the Central Nervous System in the Osseous Fishes,* by Dr. Ludwig Stieda.

In 1861, Dr. Stieda published, under the title of 'The Spinal Chord and some part of the Brain of *Esox Lucius,*' certain observations on the central nervous system of the pike. Since then he has investigated the same parts in various classes of the vertebrata, and the results so far as concerns the osseous fishes, are given in the present valuable communication, illustrated by two plates. The subject is treated under the heads of (1) the nerve-cells; (2) nerve-fibres; (3) the connective tissue and blood-vessels; and (4) the epithelia.

The *cells,* both peripheral and central, are described as bodies furnished with a vesicular spherical *nucleus,* and usually also with a *nucleolus.* They have no cell-membrane, and are consequently to be regarded as simple masses of protoplasm, which presents a finely granular aspect. These cells differ in size and form, the latter depending upon the number of processes given off, and which vary in number from one to four or five. The processes are merely continuations of the granular cell-substance, and, so far as the author has seen, are never connected with the nucleus. He regards the apparently apolar cells as artificial products, and he has never noticed any division of the processes, nor any connection between one cell and another. Besides these true nerve-cells, the central nervous substance presents numerous minute cellular elements, whose nature is not quite determined, but which have been termed "granules" from their resemblance to the so-termed "granules" in the retina. The author, contrary to an opinion he formerly entertained, is now disposed, with Gerlach and others, to regard these bodies as a kind of "nerve-cells." The nerve-cells are

described as enclosed in a delicate covering of connective tissue, which in the fresh state is closely applied to the surface of the granular cell-substance, but in chromic acid preparations becomes separated from it by a clear space, which the author denominates the "area."

2. The peripheral nerve-fibres consist of an "axis-cylinder," enclosed in a medullary sheath, and surrounded by a delicate *neurilemma* of connective tissue. The axis-cylinder is, as before said, a direct continuation of the cell substance, whilst the medullary sheath, which occupies the space between the axis-cylinder and the neurilemma, appears to commence abruptly at the nerve-cell, but to have no other connection with it. The neurilemma is described as continuous with the connective-tissue sacculus in which the nerve-cell is lodged. In the central organs the fibres consist only of the "axis-filament," and the author has never been able to trace any direct continuation of these fibres into the sheathed peripheral ones; notwithstanding the frequent assertion to the contrary of other observers.

3. The *matrix*, as it may be termed, of the central nervous masses presents different appearances in different parts. In some places it exhibits more or less of a granular aspect, and has been termed by the author the "granular matrix," whilst in others it has a finely reticulated structure, and has thence been termed the "reticulated basis-substance." The colour varies according to the greater or less prevalence of the "axis-fibres," or of the "medullary fibres" by which it is pervaded.

As regards the blood-vessels, the author has nothing particular to remark.

After these general histological observations, the remainder of the paper is occupied with a full and minute description of the structure of the spinal chord and brain, in which will be found much highly interesting information.

II. "*The Histology of the Semicircular Canals and the Otolite-Sacculus of the Frog*," by Dr. C. Hasse.

In this paper we have a very minute and detailed account of the structure of the parts in question, and a comparison between it and that of the same tissues in the Mammalia and birds.

III. "*On the Egg of the Ephemeridæ*," by Dr. H. Grenacher.

The author describes certain appearances observed by him in ova, procured from the *larvæ* of a species of *Ephemera*. The ova in question, about 0·27 mm. in length, by 0·12 mm. breadth, were furnished at either end with a semicircular appendage. These appendages were of a reddish-brown

colour, and formed rather more than half a sphere. Two distinct portions might be discerned in them, an outer, consisting apparently of radiating rods or fibres in close apposition, and a basal portion of a solid homogeneous substance, forming a short stumpy peduncle.

The author observes that these polar appendages doubtless correspond with those noticed by Leuckart in the *ova* of three other species of Ephemeridæ: *Palingenia horaria, Oxycypha luctuosa,* and *O. lactea;* and which were described by that observer as constituted of adherent masses of spermatozoa, struggling to enter the micropyle. Dr. Grenacher, however, has traced the gradual formation of these appendages from the ovarian ovum, and shows clearly enough that they are not of the nature assigned to them by Leuckart.

He farther describes other curious appendages which arise to the number of from eight to twelve in two circular zones from the source of the ovum. When fully developed, they consist of an elongated filament composed of excessively delicate fibrils, from four to six times as long as the *ovum,* and supporting at the extremity a globular *capitulum,* which seems to be fashioned something like a suctorial acetabulum. He regards these processes as serving to fix the *ovum* upon foreign bodies, and consequently terms them "anchors."

IV. "*Contributions to the Anatomy of Enchytræus vermicularis,*" by Fritz Ratzel.

This paper contains—

1. A description of a special pharyngeal system of nerves, corresponding apparently with the visceral nerves in various other annelids.

2. On the structure and development of the *receptacula seminis.*

The author is inclined, with M. Claparède, to look upon these organs, and consequently upon their homologues in the earth-worm, as representing a portion, at any rate, of the "segmental organ," and so far to agree with the views of the late Dr. Williams. A view in which, however, from a study of these parts in *Lumbricus,* we are not inclined to coincide; seeing that in that Annelid, at any rate, the segments in which the spermatic receptacles are found at the proper period, also contain at the same time the entire segmental organ; as, in fact, Buchholtz says they do in *Enchytræus* itself.

3. The salivary glands are described as branched tubular organs, which open into the ventral side of the pharynx in the third segment of the body.

4. Miscellaneous observations.—In these it may be noted

that the author describes the muscular tissue in all parts as transversely striated, which is a very remarkable circumstance, as it is certainly not so in *Lumbricus*.

V. "*Supplementary observations on the Anatomy and Classification of the Holothuriæ*," by Dr. Emil Selenka.

This is in continuation of the author's previous paper on the same subjects in vol. xvii of the Zeitsch. f. wiss. Zool., 1866; since which he has been able to examine most of the Holothuriæ in the Berlin Collection, and the whole of those contained in the Zoological Museum at Paris.

The present paper contains systematic description of several new genera and species.

VI. "*Contribution to the Knowledge of the Sexual Reproduction of the Infusoria*." Of this paper we have given a translation in another part of the journal.

VII. "*M. Landois' Theory contradicted by Experiment*," by Emil Bessels.

The author shows by direct experiment, and apparently quite successfully, that the strange assertions propounded by M. Landois (Zeitsch., Bd. xvii, 1867, p. 375), that the different sexes in the hive-bee depended upon the food upon which the larvæ were nourished, and not, as shown by Dzierzon and Siebold, upon the impregnation or non-impregnation of the ovum, is opposed to fact, and that the latter is a true explanation. And that notwithstanding the discovery by Claus of the long-wanting male of *Psyche helix*, the dogma that fertilised ova alone are capable of development, does not hold universally.

8. "*On the terminations of the Gustatory Nerve in the Frog's Tongue*," by Th. W. Engelmann.

After a brief notice of the different views on this subject entertained by Billroth, Fixsen, Hoyer, and Axel Key, the author gives the results of his own observations, which are in the main in accordance with and confirmatory of those of the last-named author.

The rounded terminal surface of the *papilla fungiformes* presents three distinct forms of epithelial cells, which are termed from their form the *calyx-cells, cylinder-cells,* and *furcate-cells;* all of which are peculiar to that part of the papilla alone.

The calyx-cells, which are by far the largest of the three kinds, constitute the greater part of the epithelium, and when viewed on the surface exhibit a sort of hexagonal, tesselated appearance; and they constitute the outermost layer of the epithelium. The *cylinder-cells* are, as the name implies, elongated, slender bodies, extending from the deeper

layer of the epithelium to the surface passing between the interstices of the larger cells. Between the two are situated the third or forked kind of cells, if such they can be called, consisting of a fusiform body with delicate processes, which arise from either pole and in varying number. Those springing from the peripheral pole penetrate between the calyx-cells to the free surface of the epithelium; and they are frequently divided once or twice dichotomously. The processes arising from the opposite or centrad pole, and which in appearance resemble an axial nerve-fibre, also subdivide once or twice, and appear to terminate in the connective-tissue *substratum* of the papilla.

A branch of the gustatory nerve on entering the papilla, divides into a leash of branches which divide and subdivide, till at length they form or terminate in a sort of cushion upon which rest the central processes of the cylinder- and furcate-cells. In this nerve-cushion may be observed very delicate fibrillæ, but whether or no these are continuous with the inner processes of the furcate-cells has not been ascertained, though there appears to be every probability in favour of the view that they do.

Max Schultze's Archiv fur mikr. Anatomie. Part IV, 1867.

I. "*A Contribution to the Knowledge of the Lymph-vessels of Birds,*" by Dr. S. Kostarew.

II. "*Researches on the Liver of Vertebrates,*" by C. J. Eberth, of Zurich.

This is an interesting paper just at the present time, when the structure of the liver is so much under discussion. The researches of Hering, and the natural injections of Chrzonszczewski, have shown that the finest branches of the gall-ducts ramify between the ultimate liver-cells in mammals, bounded by only two cells, whose sides are grooved to form the channel; in other vertebrata surrounded by a larger number of cells, large in size relatively, but still more closely approaching a typical gland duct. Eberth has already published in 'Virchow's Archiv' an account of his investigations, in which he points out the complexity of the structure of the mammalian liver, as compared with that of Batrachians in particular. In the present communication he gives a special account of the comparative histology of the liver, illustrated with a beautiful coloured plate. The two points which he discusses are: 1st. The gall-capillaries, their structure, and distribution. 2nd. The pigment of the liver, and its variation in the amphibia. He alludes to Hering's paper with high praise, but at the same time expresses a disagreement with him as to the lateral blindly-ending process of the

gall-capillaries, and as to the membrane of the finest gall-vessels. He describes his method of preparation and injection, which in amphibia appears to have depended on the absorption of fluids injected beneath the skin while the animal was living. He figures the small lateral processes spoken of, and with regard to the membrane of the ducts observes that whether it be considered as a development of intracellular substance, or formed by the cell-walls, there is a true cuticle to the finest ducts. The observations on the development of pigment in the liver in amphibia are extremely interesting. Amongst other facts observed, Herr Eberth found that in the Salamanders in spring, the cortical substance of the liver, and its continuation in the deeper parts of the liver, consists of a mass of cells, exhibiting active amœboid movement.

3. "*Studies on the Structure of the Cerebral Cortical Substance,*" by Dr. R. Arndt.

4. "*The Ciliary Muscle of Man,*" by F. E. Schultze.

This paper give a most minute account of the attachments and distribution of the fibres of the ciliary muscle, illustrated with a coloured plate. The author has used chromic acid in his studies. He remarks that the results of this anatomical investigation lead to a theory of the accommodation of the eye in sight, identical with that of Helmholz, for all the movements required by Helmholz's theory are provided for. We already have learnt that, in the movement of accommodation, the stretching of the zonula leads to the decrease of the curvature of the anterior surface of the lens, and the consequent pushing forward of the middle and pupillary edge of the iris. It is quite clear that a small contraction of the side of the lens must take place by this curvature of the middle, because the mass of the lens cannot be changed more or less. Consequently it is easy to understand the small decrease in the curvature of the posterior face of the lens, the mid-point of which never leaves its place, as well as the small retrocession of the outer edge of the iris, both which phenomena may be ascertained in the living subject during the process of accommodation. The widening of the pupil in accommodation for near objects can be explained, Professor Schulze considers, by his view, in consequence of the compression of the arteries of the iris which pass into and run along the ciliary muscle, whilst the exit of the blood through the veins is not in any way checked. The experiments of C. Völker and V. Hensen on dogs, by irritation of the ciliary nerve, agree with the results arrived at by the author's anatomical investigation.

5. "*Embryological Note,*" by Dr. V. Hensen.

6. "*The Epithelium of the Papillæ Vallatæ,*" by Dr. G. Schwalbe.

This paper is of importance in connection with the very detailed paper on Epithelium, published in the second part of the 'Archiv,' by Dr. Franz Eilhardt Schulze. It also is remarkable that Dr. Christian Lovén, of Stockholm, has arrived at results very similar to those of Dr. Schwalbe. Dr. Lovén's paper is translated in the first part of the 'Archiv' for 1868, and at the same time the detailed paper of Dr. Schwalbe, of which the present is only a preliminary notice, is promised. He has found in the pavement-like epithelium of the papillæ vallatæ of the *mammalian* tongue, large flask-like bodies or open cells, which he considers, without doubt, are the analogues of the end-organs of the nervous glossopharyngeus of fishes, described by Franz E. Schulze in the paper already alluded to. Although their connection with the sense of taste is not certain, he will call them, as Professor Max Schulze suggests, "schmeckbechers" (taste-cuplets). In a further paper he hopes to show the relation of the nerve twigs and the connective tissue which lies beneath the cells or cuplets. This is known to be peculiarly rich in fine nerve twigs, some of which W. Krause traced to end-bulbs in the tips of secondary papillæ. It is noticeable that the "schmeckbechers" do not appear on the free surface of the papillæ, but in the wall and fossa, where there is an accumulation of fluids.

Part I, 1868.—1. "*The Adenoid Tissue of the Pars nasalis of the Human Pharynx,*" by Professor Dr. Hubert von Luschka.

The rounded follicular developments at the back of the pharynx, which in many ways closely resemble the Peyer's glands of the intestine, form the subject of this paper. The distribution of the structures, and the minute arrangement of the tissue, are carefully considered, and illustrated in a plate.

2. "*On Rods and Cones of the Retina,*" by Dr. W. Steinlin.

3. "*Remarks on Dr. Steinlin's Paper,*" by Max Schultze.

Dr. Steinlin remarks that since Professor Max Schultze has endeavoured to establish a physiological difference between rods and cones, it is necessary to be very exact in the use of those terms. He has himself described the rods of birds, amphibia and fishes, as cones (Zapfen), deprived of the fat-drop. He, therefore, proposes to call every element of the columnar layer of the retina, which consists of three parts clearly separable from one another—Cones (Zapfen):

and the three parts—respectively cone points, cone bodies, and cone tails. He says that Max Schultze and Hasse have only distinguished an outer and an inner division of the cone, but that Max Schultze's "lens-like body" corresponds to his "cone-body." After some further remarks on the significance of these parts, Dr. Steinlin alludes to the observation made by Max Schultze, that the "cone-points" are striated, and states that he has often seen this himself, but did not regard it as a normal structure. He now, however, compares it to the structure found in the cones of the eyes of crustacea. He particularly describes the case of *Squilla*, in which he found the striated portion breaking up into series of four small laminæ, or plates transversely. Professor Max Schultze, in his remarks upon Dr. Steinlin's paper, points out what he considers the errors in that communication. He regards the columnar elements of the retina as differing in this, that whereas the rods have their outer division ("point" of Steinlin) of a cylindrical shape, the cones have that division of a conical shape. The distinction does not rest at all in the presence or absence of a lens-shaped body (the third division of Steinlin), but in this difference of form. The rods are the fundamental organs of vision, to which the cones are in certain cases superadded. As to the lamination of the cone in crustacea, Professor Schultze is very glad to be confirmed by Dr. Steinlin's observations. He has himself recently published a separate work on this subject, which we notice elsewhere. On other points on which Dr. Steinlin propounds new views, such as the connection of the nervous elements and the connective tissue, Professor Schultze simply expresses his complete disagreement.

"*On the Purkinjian Fibres,*" by Dr. Max Lehnert.

These fibres were discovered in 1845, by Purkinje, beneath the endocardium of the sheep, ox, pig, and deer. They have since been written on by Kölliker, von Hessling, Reichert, Remak, Acby, and others. They appear to consist principally of striped muscular tissue disposed in a very remarkable way with connective tissue. They are described at great length in this paper, and figured in a large plate.

"*On the Structure of the Spinal Ganglia, with Remarks on the Sympathetic Ganglion-cells,*" by Dr. G. Schwalbe.

This appears to be a valuable paper; it is of considerable length, and well illustrated. The author has used iodine-serum largely in his observations.

"*Researches on the Tooth-pulp,*" by Franz Boll.—This paper is by a medical student of Bonn—one of Prof. Max Schultze's pupils. The points to which he has directed his

attention are, first, the mode of termination of the nerves of the tooth, which is a subject as yet but little investigated; and, secondly, the relation of the intertubular dentine substance of the tooth to the tooth-pulp, and the development of the former from the latter. He has found the long incisors of Rodents admirably adapted to this investigation, and in examining the nerves has made use of the terchloride of gold, which was lately recommended by Cohnheim, and used by him in the investigation of the nerves of the cornea. With regard to the first of these matters in question, he states that extremely fine nerve filaments pass between the pulp-cells, and penetrate the dentine of the tooth, just as do the processes from the peripheral cells of the pulp: hence it is necessary to distinguish two sorts of dentinal canals—those which contain processes from the pulp-cells, and those which contain nerve-fibres. (See Plate II, fig. 3). Three views as to the origin of the intertubular substance of the dentine have been current: one is Kölliker's, who conceives it to proceed from the calcification of a soft matrix excreted from the dentinal cells and their thin prolongations; the second is Waldeyer's, who modifies Kölliker's view considerably, and denies the existence of a præformative membrane to the pulp. He maintains that the formation of the dentine consists in the conversion of a part of the protoplasm of the dentinal cells into a collaginous substance, which is subsequently calcified, while the remaining part of the cell-protoplasm continues in the form of soft fibres to occupy the interior of the tube surrounded by the calcified substance (figs. 1, 2). H. Hertz, in a paper published in Virchow's 'Archiv,' 1866, states that the intertubular substance of the dentine is the chemically changed and calcified intercellular substance of the pulp-cells. Herr Boll proceeds to discuss the views of Waldeyer and Hertz, but fact after fact has convinced him that Waldeyer is correct. He gives several figures of the peripheral-cells of the tooth-pulp—the odontoblasts—with fromone to four processes projecting into the dentine substance. One of his sections (fig. 2) shows the cells completely detached from contact with the dentine, excepting through their long, fine processes; and it is most clearly seen that there is no connection between the hard substance of the dentine and any intercellular matter of the pulp: in fact, no such intercellular matter exists at the periphery. The limitation of the hard substance of the dentine where it comes in contact with the cells of the pulp is termed *membrana eboris*. The multiplicity of processes from the odontoblasts, instead of a single fibril, as originally described by Lent, is an interesting observation.

"*Contributions to a Knowledge of the Structure of the Taste-papillæ of the Tongue,*" by Dr. Christian Lovén. Translated from the Swedish.—This is an important histological memoir, illustrated with a plate.

"*The Hearing-organ of the Stag-beetle*" (Lucanus cervus), by Dr. H. Landois (figs. 4, 5, 6).—There is no insect in which the nerves of the head can be more beautifully or more readily prepared than the Stag-beetle. The nerves are particularly large in relation to the brain, and may be well dissected under spirit. The antennary nerve is very large, and by slitting up the antenna it may be traced even to the last joint, in the cavity of which it gives rise to a peculiar structure. If the terminal bit of the antenna of the stag-beetle be examined, even with the naked eye, a small point-like depression can be detected both on the under and upper surface. These pits occur in male and female specimens both, varying only with the size of the antenna; they occur only on the terminal-joint, which has a peculiar shape, like that of the sole of a boot. The pits are seen, with a magnifying power, to lead into the inside of the antennal plate. Cross sections and a solution of concentrated nitric acid and chlorate of potassium are used in the further investigation. The aperture of the pits is somewhat circular, and internally they have a pitcher shape. The whole plate-bit or joint is covered externally with hairs, which are of two sorts—small and large. They are all short and thick proportionately, and the large ones, which are fewest in number, are seen to be provided with a swollen knob-like base. The integument presents two chitin-layers, of which the inner is rendered separable by the treatment with acid. The outer is excavated by large pitcher-shaped canals, from which the hairs emerge. Beneath lies the hypodermis of rounded nucleated cells. Three or four expanded tracheal vesicles lie in the middle of the terminal-joint, connected with the general antennary trachea. The nerve, which is the important thing in this organ, enters it as a single stem of some thickness, which then splits up into three or four branches spreading out in the "plate." The nerve and these branches are covered with a conspicuous neurilemma, in which are many nuclei. Fine twigs proceed from the branches in every direction towards the surface of the organ, devoid of a neurilemma. The end-organs of these branches are very peculiar. Each nerve-twig on reaching the hypodermis gives rise to a large oval ganglion-cell, which lies just below the chitinous layer, and corresponds in position to one of the flask-shaped canals from which the hairs of the surface emerge. The ganglion-cell is continued up into this

cavity, exhibiting here an axis-fibre of nerve-matter, which terminates in apposition with the knob-like base of the hair, so that each hair is in direct connection with a nerve-fibre, through the interposition of a ganglion-cell. Dr. Landois refers to certain structures seen by Leydig in Diptera and in Water-beetles, which appear to be identical, and were considered by Leydig as organs of hearing. He then discusses the probability of this being an auditory organ. It presents, he maintains, the same essential structure as that demonstrated by Hensen in Crustacea—a depression (the "pits") provided with hairs in connection with nerve-fibres. It has not at all the necessary structure of an organ of smell, and that function must be put out of the question. Experiment shows that there is some other means by which smell acts. A stag-beetle, subjected to the action of sulphurous acid, ammonia, or tobacco-smoke, struggles and moves its antennæ back from the irritating substance; but if the terminal-joints be now cut off, which contain the organ in question, the beetle still exhibits the same movements, which shows that the antennæ's movements must depend upon some other source of nerve-irritation than is provided in the terminal joint. It is very probable that the antennæ serve as organs of touch, for soft, small objects, when drawn across them. Dr. Landois considers that it is the large hairs which subserve this purpose, the smaller ones being protected from contact by the superior size of the larger hairs. The small hairs he considers as responding to the vibrations of sound. The "pits" are arranged in such a way, Dr. Landois observes, as to concentrate more or less the waves of sound, and the presence of the trachean-vesicles is best explained if the organ is considered as auditory, since they would act as additional vibrating structures. The measurements of the various parts are given in great detail, as also in a species of Dorcus. A plate, with four large and very well executed figures, accompanies the paper, from which we extract three.

Bibliothèque Universelle et Revue Suisse.—In this excellent journal are frequent notices of German, Italian, Russian, Swedish, and other memoirs, with critical notes from the able hand of the distinguished naturalist, Professor Claparède. Some of these we shall from time to time here translate.

February. "*Om Vestindiens Pentacriner,*" by Dr. Lütken. —In a very interesting notice of recent researches on the living crinoids by M. Claparède, in which he sketches the observations of Carpenter and Wyville Thompson recently published in the 'Philosophical Transactions' (whither we must refer the reader), a paper by the Scandinavian naturalist,

Lütken, is also noticed. His studies have been more zoological than anatomical, and refer not only to the Antedons (*Comatulæ*), but also to the Pentacrini. He shows that the first are not merely Pentacrini detached from their peduncle, and that the second also are not merely Antedons which have preserved their larval stalk. Amongst fossil Pentacrini but one is known, figured by Buckland, of which the calyx is entirely preserved. From the disc of this animal a sort of recurved rostrum is seen to issue with an aperture at its end, which has been considered the mouth. But since the living Pentacrini, as M. Lütken observes, agree with the Antedons as to mouth and arms, it is evident that the rostrum is an anal tube. Müller was aware of this. It is, however, to be remarked that among the Comatulæ, some, as the Antedons, have a central mouth, with a more or less eccentric anal tube whilst others, as the Actinometræ, have a central anal tube, and a lateral mouth. Therefore we may expect similar differences in the Pentacrini. Another explanation of the tube of certain fossil crinoids is, that in them the anal and oral apertures are united. If this be the case, it cannot be regarded as in the Ophiuridea, and the Asteridea with conical ambulacral vesicles, as resulting from the suppression of the anal aperture, but rather must be looked at as the assumption of oral functions by the anal aperture.

Note on the Polymorphism of the Anthozoaria and the Structure of the Tubipora," by Alb. Kölliker.—The polymorphism of individuals, so remarkable among the Acalephæ, had till now no parallel among the other Cœlenterata. It is, therefore, a discovery as little expected as that of a veritable polymorphism, which Professor Kölliker has made among various genera of Anthozoaria, and Alcyonaria. This polymorphism consists in this, that besides the large individuals susceptible of taking nourishment, and provided with generative organs, there exist also other smaller, asexual polyps, which appear to preside essentially over the introduction of sea-water into the organism, and its expulsion, and which are, perhaps, at the same time the seat of an excrementitious secretion. These asexual individuals possess, like the others, a body-cavity divided into chambers by eight septa, and a pyriform stomach furnished with two apertures. They are entirely destitute of tentacles, and in place of the eight ordinary mesenteric filaments, no more than two are found applied over two consecutive septa. The cavity of the body of these individuals is always in communication with that of the sexual individuals, but the manner in which this communication is established is liable to vary with the genera. Two

types can be distinguished in regard to the mode of distribution of the sexual individuals, on the polyparies. In the first they are distributed in great number in all the polypigerous region of the polypary, between the sexual individuals. Thus amongst certain Alcyonia, which Professor Kölliker places in the genus Sarcophyton, in the Veretilla, the Lituaria, the Cavernularia, and the Sarcobelemmon. In the second case the asexual individuals are restricted to certain places, perfectly definite, but varying with the genus. Thus, in certain Pterœides they are found on the inferior face of the pennatea leaflets of the region, serving for attachment under the form of a plate of more or less size: in other species of the same genus, they are found besides at the summit of the polypary: in the Pennatulæ, the varicosities of the trunk correspond to the place where the sexual individuals are situate; *Funiculina quadrangularis* exhibits them disposed in longitudinal ranges between the sexual individuals; whilst the Virgulariæ always present behind each leaflet, on their trunk, a simple transverse range of asexual individuals.

It is probable that all the Pennatulidæ present a like dimorphism, at least among the Renillæ polyps may be seen well-developed from secondary bodies, which appear to be individuals of a different form. On the other hand, with the exception cited above of the genus Sarcophyton, Professor Kölliker has sought in vain for dimorphism among the Alcyonidæ and the Gorgonidæ. It must not be forgotten, too, that there appear to exist relations between the buds of the sexual and asexual individuals in the polymorphic polyparies, for in the Veretilla at any rate, the asexual individuals appear to be able under certain circumstances to transform themselves into sexual individuals. Professor Kölliker has also studied a polypary of Tubipora still enveloped in its soft parts, and coming from the Viti archipelago. In spite of the great resemblance between the polyparies of Tubiporæ, and those of the madrepores, the author has convinced himself that by all their structure and their development these polyps are Alcyonaria which ought to take place by the side of the genus Clavularia. Both the tentacles and the bodies of the polyps of Tubiporæ contain spicules.

"*On an Hermaphrodite Nemertine from Saint-Malo,*" by Professor Wilh. Keferstein.—Formerly a great importance was assigned in zoology to the union of the sexes in the same individual, or to their separation in distinct individuals. Even recently a French *savant* has tried to class the invertebrata in great measure by this character. It is certain, however, to-day that the monœcia and the diœcia have only a

secondary value. Do we not know, for instance, that both in Annelids and in Nematoids, which, as a rule, have the sexes separate, a certain number of hermaphrodite species are found? We know also some Trematods which are diœcious in a group, otherwise entirely hermaphrodite. And recently in the group of the hermaphrodite Planarians, has not a diœcious species been made known (*Planaria dioica* of St. Vaast, described by M. Claparède)? Thus the discovery made by M. Keferstein at Saint-Malo of an hermaphrodite Nemertine, is not at all surprising. But it is nevertheless very important, as it is the first case of hermaphrodism in this group. In this animal, to which M. Keferstein gives the name of *Borlosia hermaphroditica*, the testicles have been found filled with ripe zoosperms and the ovaries full of ovules in course of formation. The author having only studied a single individual, one may suppose that the organs designated by him testicles are only spermatic receptacles filled with sperm. However, Professor Keferstein believes that he has reason to be convinced that such an interpretation is false. However that may be, the author suggests that the discovery of an hermaphrodite Nemertine throws some light on the Nemertians in the perivisceral cavity of which Max Schultze, Claparède, and Keferstein himself have found small, living Nemertians well developed.

Robins' Journal de l'Anatomie. January, 1868. "*Researches on the Nerves of the Neurilemma, or Nervi-nervorum,*" by M. C. Sappey.—The neurilemma receives nerve-fibres which are to the nerves what the *vasa vasorum* are to the vessels, whence the name of *nervi-nervorum*, under which M. Sappey proposes to describe them. Their existence in the fibrous coat of the nerves had not yet been pointed out; it is constant nevertheless, and can be easily demonstrated. The disposition which the nervi-nervorum take in the neurilemma differs little, however, from that which the nervous ramifications in the other dependencies of the fibrous system present. Like these, they follow in general the arteries: like these also, they anastomose freely. It is not only in the common or principal sheath that one meets them, but also on those which surround the principal fasciculi, and the tertiary fasciculi. M. Sappey has also followed them on to the sheaths of the secondary fasciculi. But, in proportion as the calibre of the sheath diminishes, they become more delicate and fewer. One never sees them extending on to the envelope of the primitive fasciculi, (an envelope which is quite different from the preceding and which has been studied by M. Ch. Robin, under the name of perinéure ('Comptes Rendus,' 1854).

The absence of the *nervi-nervorum* on the sheath of the primitive fasciculi explains to us their absence from certain large nerve-branches. The tubes which compose them are remarkable for their extreme tenuity. Each of them, however, is composed of an envelope, of a medullary layer and of a cylinder axis. The optic nerve possesses two fibrous envelopes; 1st. A very thick external envelope, which extends from the optic tract to the globe of the eye, and which constitutes for this last organ a sort of ligament; 2nd. An internal envelope which is very fine, and from which septa are given, which dividing, and subdividing, and uniting one with another, form longitudinal canals, all of about the same diameter. This second envelope, which has the same relation to the optic nerve as has the neurilemma to other nerves—receives not the smallest nervous twig. The external envelope, on the other hand, receives a great number which take their origin from the ciliary nerves. These *nervi-nervorum* of the external sheath run at first in the superficial layers, where they form an irregular plexus, and send off a few branches to deeper layers. The external sheath of the optic nerves, so rich in nervi-nervorum, is remarkable also for the abundance of the elastic fibres, which enter into its formation. It was formerly very erroneously considered as a uniting link between the dura mater and the sclerotic. It differs, however, from both; 1st. By its elastic fibres which are deficient in both; 2nd. By its *nervi-nervorum*, which are of an extreme rarity in the cranial dura mater, and of which no vestige is seen in the sclerotic. The anatomical analysis, therefore, far from confirming the analogy which so many anatomists believed to exist, attests that this part on the contrary is distinguished from the two membranes with which it is continuous by characters which are peculiar to it.

"*Pulmonary Epithelium*," by C. Schmidt. Thesis at Strasbourg, 1866. A notice of this memoir, which appears one of some value, is given. The conclusions of the author are—1. In the three classes of Vertebrates (fishes, reptiles, mammals), the whole extent of the respiratory apparatus is lined by an epithelial membrane. 2. The trabeculæ in the reptiles, and the bronchia in the mammals, are clothed with a cylindrical vibratile epithelium. 3. The terminal parts of respiratory apparatus (vesicles, alveoli, aerial cells) in which the exchange of gases between air and blood takes place, are lined with a simple pavement epithelium, without vibratile cilia. 4. The passage from vibratile epithelium to pavement epithelium takes place gradually. The last divisions of the bronchia possess only pavement-cells, not vibratile. 5. The

alveolar epithelium is *continuous* and *complete*. It covers the capillaries in all directions. The cells which constitute it present varieties in their disposition according to the different classes of animals. 6. *Amphibia.*—Cells of uniform size, flattened at that part which covers the capillaries, dilated into an ampulla, enclosing the nucleus, at the intervals of the capillaries. 7. *Reptiles.*—Two sorts of cells. One, the smaller, containing a nucleus, united in groups in the intervals of the capillaries; the other, larger, flattened without contents, placed between the groups of little cells, and covering over the capillaries. 8. *Mammalia embryo.*—Cells regular and of uniform size. *Newly-born.*—A part of the preceding cells increase in size and cover the capillaries; the others do not exhibit any change, and remain united in groups in the meshes of the capillaries. *Adults.*—The cells are united in smaller number to form the groups; many from among them are isolated. The large cells which separate the groups seem to fuse themselves in part and take the aspect of very thin and nearly amorphous membranous plates.

"*On the Anatomy and Physiology of the Erectile Tissue in the Genital Organs of Mammifers, Birds, and some other Vertebrates,*" by Ch. Legros.—This is an excellent résumé of the subject, and is illustrated by five good plates. The most detailed and careful account of the structures is given, and certain new explanations given.

"*Zoological and Anatomical Researches on the Glyciphagi, with Palmate or Plumose Hairs,*" by MM. Fumouze and Ch. Robin.—Several species of Acaridians have been described in his journal by M. Robin. In the last number we noticed detailed studies of *Tyroglyphus;* in the present the two species of Glyciphagus, *G. Palmifer* and *G. Plumiger,* are very fully described and figured in five plates. These forms are chiefly remarkable for the very large branched hairs which project from their bodies. *G. Plumiger* has hairs not unlike those of the shore-crab, while those of *G. Palmifer* are broad leaf-like expanses, exhibiting a central shaft and numerous cross pieces.

Miscellaneous.—*A new Animal Colouring Matter in the Spectroscope.* Professor Church, of Cirencester, has discovered a very interesting colouring matter in the crimson feathers of the Turacou of South Africa, a bird which is well known as sometimes washing out its own colour. Mr. Ray Lankester in a paper read at the British Association at Dundee, stated that he had failed to obtain any definite bands of absorption from the colouring matter of bird's feathers,

though examined when in solution in ether as well as in the feather. Professor Church's discovery of Turacin is therefore very interesting, as this colouring matter gives in the feather two absorption bands quite close to those of scarlet cruorine, but sufficiently distinct to be readily recognised. Turacin is readily soluble in ammoniacal water, and gives a solution the absorption bands of which differ greatly from those of the feather, being much "higher." Acids precipitate the Turacin again in its original form. Professor Church has made careful chemical analyses of Turacin, and finds it to contain copper. Many amphibia and fishes are coloured by copper. Professor Church considers that this new body has some relation to cruorine, but in all its reactions and in its spectroscopic characters it is most obvious that the two bodies are very distinct. They only *happen* (as alkanet root does too) to give two absorption bands in nearly the same part of the spectrum.

Green Wood.—The spores of *Peziza eruginosa* multiply in rotton wood in such abundance as to give it a bright blueish, green aspect. Such wood is used by the turners of Tunbridge Wells in their ornamental work. A great stir has recently been made with regard to similar wood found in the forest of Fontainbleau. Two French chemists have examined it, and one terms the green colouring matter Xylochloric acid, whilst the other gives it an equally euphonious title Xylindein. The colouring matter should be examined with the spectroscope in order to ascertain if any absorption bands are present, and if possible, what relation this colouring matter has to those described by Dr. Ferdinand Cohn.

NOTES AND CORRESPONDENCE.

Eulenstein's Series of Diatomaceæ.—In the 'Journal' for January, 1867 (p. 64), we took occasion to call attention to a prospectus which had been issued by M. Eulenstein of Canstadt, respecting two Series of Collections of Diatomaceæ which he was proposing to issue, each in five Parts, containing 100 species. Owing partly to illness, and partly to the large number of subscribers, the issue of these collections has been somewhat delayed, but we have now before us the First Century of the second or "Standard" series, which contains the following species, amongst which those marked with an asterisk are from original specimens or gatherings. The specimens appear to be in an admirable condition, and to be well mounted, and the present issue shows that M. Eulenstein's laborious and most useful design will, doubtless, be carried out in the manner to be expected from his well-known reputation. We are sorry to find that, in consequence of the undertaking, on the original terms, proving more expensive than was anticipated, a reissue of the series could only take place at a somewhat advanced charge, which, however, would then leave the collection very cheap.

The specimens in the present collection are, with few exceptions, quite unmixed, and remarkably clean. In most cases both entire frustules and separate valves are given, and in some the entire organism is preserved in a fresh state in one slide, and the cleaned valves in another. Many of the species, as will be seen, are of considerable rarity.

List of the species of Diatomaceæ contained in the First Century of 'Eulenstein's Typical Series':

Achnanthes longipes
,, brevipes
*Achnanthidium lanceolatum
* ,, lineare
Amphipleura pellucida
Amphiprora paludosa
,, Pokornyana
Amphitetras antediluviana
*Hemiaulus polycystinorum
* ,, alatus ?
Homœocladia martiana
*Hyalosira obtusangula
Isthmia enervis
Licmophora flabellata
Mastogloia lanceolata
* ,, elegans

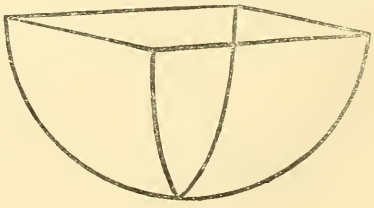
Amphora ovalis
„ salina
„ arenaria
Arachnodiscus ornatus
Aulacodiscus orientalis
Berkeleya fragilis
„ Dillwynii
Biddulphia pulchella
Campylodiscus clypeus
Cerataulus turgidus
„ lævis
Ceratoneis arcus
Chætoceras armatum
Cocconeis pediculus
„ scutellum
„ Grevillei
Coscinodiscus omphalanthus
*Cyclotella rectangula
Cymatopleura apiculata
Cymbella gastroides
*Denticula obtusa
* „ thermalis
*Diatoma grande
„ hiemale
Donkinia carinata
*Encyonema prostratum
Endosigma eximium
Epithemia turgida
„ argus
„ sorex
* „ constricta
Eunotia pectinalis
„ undulata
Fragilaria virescens
„ mesolepta
* „ minima
* „ Harrisonii
Gomphonema tenellum
„ acuminatum
„ geminatum
Grammatophora marina
*Melosira nummuloides
Navicula nobilis
„ oblonga
„ lata
*„ Brébissonii
„ cryptocephala
„ affinis
„ serians
„ sphærophora
„ cuspidata
Nitzschia obtusa
* „ Palea
„ tenuis
* „ lanceolata
„ Closterium
Orthosira Rœseana
* „ Dickieii
„ arenaria
Pleurosigma strigosum
„ balticum
„ attenuatum
„ acuminatum
Rhabdonema arcuatum
Rhoicosphenia curvata
Schizonema Grevillei
*Scoliopleura tumida
Stauroneis Phœnicenteron
Striatella unipunctata
Surirella biseriata
„ gemma
„ ovata
*Synedra pulchella
* „ Vaucheriæ
„ splendens
* „ affinis
„ fulgens
Tabellaria flocculosa
Terpsinoë musica
*Tetracylus lacustris
Triceratium arcticum

Test-Diatoms.—When one speaks of "test," how is it possible that *Navicula affinis* and *N. rhomboides* can be confounded? These diatoms do not resemble each other in any way, either in form or in the fineness of their striæ. *Navicula affinis* is always distinguished by the line or nervure which runs along the margins of the valve, which is gently contracted towards its extremities, and the ends of which are rounded off. The striæ, though difficult to resolve, are much less closely packed (46·60 in ·001″) than those of *N. rhomboides*. Different authors, however, have described and drawn

the one for the other. The opticians often give to *N. affinis* the name of *N. amici*, no doubt because this diatom was the favourite test of that able micrographer. *N. affinis* is also confounded with the *N. gracilis*, *N. rhombica*, *N. cuspidata*, &c., in such a way that it is sometimes difficult to recognise them. I have said that the two diatoms in question ought not to be confounded. In fact, whilst the *N. affinis*, with the elliptic valve, is pinched up towards its ends, it is quite otherwise with *N. rhomboides*, which has a nearly quadrangular form, and the ends of which are lanceolate. The striæ of this diatom (85 in ·001″) make it a test of the first order. What astonishes me is that certain authors of consideration, such as MM. Arthur Chevalier, Henri Van Heurck, Heinrick Frey, and many others, have not given to the diatom, which they describe as the *N. affinis*, or test of Amici, its real name. Lastly, it appears that M. de Brébisson, the able French micrographer, in a new work, which he is preparing on the diatoms, has dedicated to one of these authors, M. Henri Van Heurck, a genus Vanheurckia, which ought to comprise *N. rhomboides*, *crassinervis*, *cuspidata*, *ambigua*, *collet. viridum*, and *vulgare* Perhaps this will preserve us from the approach of complete confusion.—Mouchet, Rochefort-sur-mer.

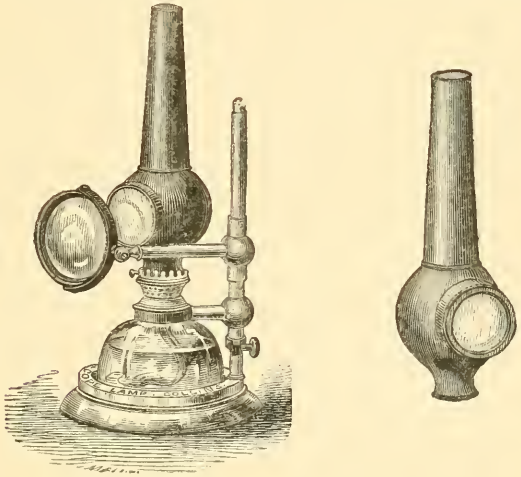
Corethra plumicornis.—The note on the Bibliography of this interesting insect and its larvæ, which appeared in the Notes and Correspondence of the October number of the 'Journal,' in which number, also, Professor Jones's paper appeared, should have been signed "T. Rymer Jones," since it was sent for publication to the Editors by that gentleman.

Note on a Proposed Form of Condenser.—By the intersection at right angles of two equal and similar half-cylinders, whose flat sides are in the same plane, a solid is formed, which is represented in the accompanying figure.



Were such a solid made of glass, and placed below the stage of the microscope, with its square side uppermost, rays entering its curved surfaces in directions parallel to the axis of the instrument would all be focalised into two lines, or narrow spaces, intersecting each other at right angles. The light would increase in intensity towards the centre of the field. By stopping off a *diagonal* half of the square side I think that a form of illumination would be obtained well adapted for exhibiting at the same time the longitudinal and transverse lines of *Pl. fasciola, Nav. rhomboides,* &c.—William Robertson, M.D., Edinburgh.

Fiddian's Metallic Chimney. At the last meeting of the Royal Microscopical Society Mr. C. Collins exhibited a novelty in the way of a chimney, shade, and reflector combined for the microscopist's lamp. The chimney is very light, being made of thin copper, and without a seam, therefore not likely to open out or crack with any amount of heat



COLLINS' FIDDIAN METALLIC CHIMNEY.

that may be applied; the inside is coated over with a material of intense whiteness. An aperture is left in one side, as shown in the woodcut, for the insertion of a circular piece which carries a thin glass, either plain or tinted, through which the rays of light are emitted in one direction only. The durability, and consequent economy of such a constructed chimney, setting aside other qualities, is a recommendation of no small importance.

Cheap Achromatic Microscopes. Referring to the last edition of Beale, 'How to work with the Microscope,' I note that on page 10, paragraph 15, Mr. Salmon and Mr. Highly are stated to have been the first in London to bring out a good and cheap Achromatic Microscope. I take it that this remark does mean to confine itself *exclusively to London;* if this be so, I beg to inform you that this is by no means correct. My late partner and friend, Mr. A. Abraham, brought out as early as 1841 a very efficient instrument, with two sets of achromatics as powers, these last (the powers) being made by Nachet of Paris, and of which (complete in a case with apparatus) great numbers were sold at £8 retail. I am glad to be able to send you a lithograph of this instrument, with full description, printed at the time named.

Upon the principle of awarding honour to whom honour is due, I shall be glad if you will insert this in your forthcoming number.—George S. Wood, 20, Lord Street, Liverpool.

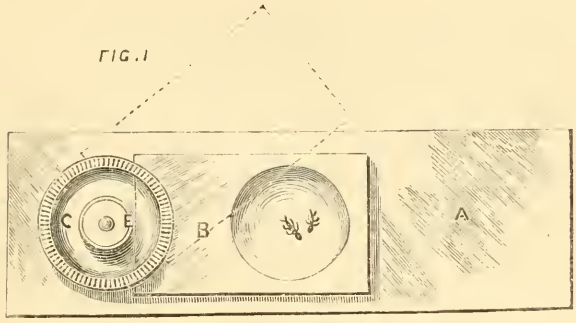
"Slide-Cell," or new Live-Box for Aquatic Objects. In the examination of these objects, which from their numbers and variety are conveniently classed under the term "pond life," I have felt the want of some apparatus which would confine them within a limited space, and yet afford means of watching their habits and processes of development. After employing the different patterns of live-boxes, troughs, &c., which have been recommended, I have found none more useful or better adapted for practical observation than the "slide-cell," and which, for the benefit of my fellow-microscopists, I briefly describe.

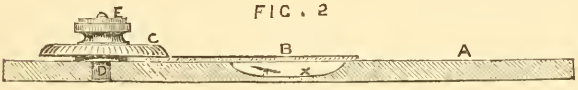
By reference to the drawing it will be seen that the apparatus can be manufactured for a few pence, and this is, of course, a recommendation.

Figures 1 and 2 are plan and section views of the "slide-cell."

A is a glass slip 3 × 1, in the centre of which a circular or oval well is "punted" out in the usual manner. B is a thin glass cover, to one end of which is attached, by shellac or other cement, a brass disc, C, having a frilled edge. A hole is drilled through one end of the slip A, and also through the centre of the disc B. Through these holes is passed a stud pin D, which has a small head at the lower end, the other end being tapped to receive a small nut, E. A thin washer of leather is placed upon the stud D, between the disc and the slip to ensure a proper bite. By unscrewing the

nut E the disc B, and with it the thin glass cover, may be removed for the purpose of cleaning, or for attaching a fresh cover in the case of breakage. On moving the disc and cover





aside, as shown in fig. 1, the object, with a sufficient supply of water, can be readily introduced; some care, however, is required in doing this, but dexterous management of the dipping tube will suffice to disperse all air-bubbles.—Thomas Curteis, F.R.M.S.

PROCEEDINGS OF SOCIETIES.

Royal Microscopical Society.

January 8th, 1868.

James Glaisher, Esq., F.R.S., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The President reminded the Fellows that the Library of the Society, at King's College, is open for their use, together with the collection of objects, microscopes, &c., on Mondays, Tuesdays, Thursdays, and Fridays, from 11 a.m. to 4 p.m.; on Wednesdays in the evening only, from 6 to 10 p.m.; and on these days Mr. Walter W. Reeves is in attendance as Assistant-Secretary, Librarian, and Curator.

The following presents were announced, and thanks voted to the respective donors.

	Presented by
Nine Slides of Test Objects	Mr. Lobb.
Journal of Linnean Society	The Society.
Journal of Society of Arts	Ditto.
Journal of Geological Society	Ditto.
Proceedings of Essex Institute, U. S.	The Institute.
Intellectual Observer	The Publisher.
Land and Water (weekly)	The Editor.
Popular Science Review	The Publisher.
Photographic Journal	The Editor.
Martin's Lectures on Natural and Experimental Philosophy	H. Lee, Esq.
A Book containing a large collection of Original Drawings, and a Cabinet of Slides of 1031	Dr. Wallich.

In bringing to the notice of the Society the gift of Dr. Wallich, the President characterised it as a splendid present bestowed in the most handsome way. He remarked upon the great scientific value of the collection of slides, which was much enhanced by the MS. and drawings which Dr. Wallich had sent with them. It would be the anxious desire of the Council to devise plans by which the valuable labours and original researches of Dr. Wallich, as represented in the objects, drawings, and MS. should be put to the best uses for the advancement and for the honour of their generous donor.

The President having read a letter from Dr. Wallich, which accompanied this valuable gift (see his Address, p. 67), proposed a special vote of thanks to Dr. Wallich, which was carried by acclamation.

The following gentlemen were duly elected Fellows of the Society:—Alfred James Puttick, ; H. Ramsden, M.A.

Professor Rupert Jones, F.G.S., then read a paper "On

Recent and Fossil Bivalved Entomostraca." (See 'Trans.,' p. 39.) This was followed by a discussion.

The PRESIDENT remarked upon the high degree of interest which microscopists felt in the organisms to which Prof. R. Jones had called their attention.

Mr. SLACK observed that, in certain specimens of *Artemia salina* obtained during the season at Hayling Island by Mr. Burr, he had noticed the presence of groups of crystals, apparently uric acid, in their intestines, and suggested that it would be advisable to ascertain if similar products were to be found in other Entomostraca.

Mr. HALL said that he had not been able to find any crystals in the specimens of Artemia he had examined.

Mr. HOGG observed that the presence of urate of soda or urates in some form might be suspected in such animals.

ANNIVERSARY MEETING.

February 12th, 1868.

JAMES GLAISHER, Esq., F.R.S., President, in the Chair.

The following presents were announced:

	Presented by
British Journal of Dental Science	The Society.
Photographic Journal	The Editor.
Land and Water (weekly)	Ditto.
Journal of Society of Arts	The Society.
Naturalists' Note Book, 1867	The Editor.
Annual Report of Surgeon General, U.S.	Surgeon General.
Journal of Quekett Club	The Club.
The Student, No. 1	The Publisher.
A Case containing selected Catalogues of Philosophical Instruments	Newton Tomkins, Esq.
Five Slides of Stagshorn in section, with the Blood in them	Thos. White, Esq.
Twenty-four Slides of Indian Bat Hairs	W. M. Bywater, Esq.

John Dawson, Esq., was elected a Fellow of the Society.

The ballot was taken for the election of Officers for the year ensuing, when Mr. Stewart and Mr. Ladd, having been appointed scrutineers, declared the election to have fallen on the following gentlemen:

President.—James Glaisher, Esq., F.R.S, &c.

Vice-Presidents.

W. B. Carpenter, M.D., F.R.S., &c.
Arthur Farre, M.D., F.R.S., &c.
The Rev. J. B. Reade, M.A., F.R.S., &c.
G. C. Wallich, M.D., F.L.S., &c.

Treasurer.—C. J. H. Allen, F.L.S., &c.

Secretaries.

H. J. Slack, F.G.S. | Jabez Hogg, F.L.S.

Council.

Charles Brooke, M.A., F.R.S.	Ellis G. Lobb, Esq.
H. C. Bastian, M.A., M.D., &c.	Richard Mestayer, Esq.
W. A. Guy, M.B., F.R.S.	John Millar, Esq., F.L.S.
James Hilton, Esq.	Major S. R. I. Owen, F.L.S.
W. H. Ince, F.L.S.	Thomas Sopwith, M.A., F.R.S.
Henry Lee, F.L.S. & G.S.	F. H. Wenham, Esq., C.E.

The Auditors presented the Treasurer's Report for the past year. (See 'Trans.,' p. 59.)

The Cabinet and Library Committees duly presented their Reports, which were read and ordered to be entered on the Minutes. (See 'Trans.,' p. 55.)

The PRESIDENT then delivered his Annual Address, which he was requested to print for distribution among the Fellows.

March 11*th*, 1868.

J. B. READE, F.R.S., Vice-President, in the Chair.

The following presents and purchases were announced:

	Presented by
A Photographic Portrait of Prof. Bell, F.R.S., framed and glazed	T. Bell, Esq.
Journal of Society of Arts	The Society.
Land and Water (weekly)	The Editor.
Journal of Dental Science	Ditto.
Journal of Linnean Society	The Society.
Photographic Journal	The Editor.
The Student, No. 2	The Publisher.
Formation of so-called Cells in Animal Bodies. Ed. Montgomery	Dr. Murie.
American Patent Office Reports, 4 vols., 1863-4	Commissioners of Patents, U. S.
Quekett's Histology, vol. 1.	Thomas White, Esq.
Five Slides of Hippuric Acid	Ditto.
The Annals of Natural History.	Purchased.
A Monograph of British Entomostraca, by Norman and Brady	Ditto.
Johnston's History of British Zoophytes. 2nd edition	Ditto.
Darwin's Origin of Species. 4th edition	Ditto.
The Variations of Animals and Plants under Domestication, Darwin	Ditto.

The presents to the Society included a series of nine slides, with models of the jaws and rotatory apparatus of a Rotifer, from the Rev. Lord S. G. Osborne; a very valuable and complete series of preparations of bones and teeth, numbering 424 slides, from Mr. Joseph Beck, to whom a special vote of thanks was moved, and carried by acclamation; a first-class binocular microscope with glass shade had been purchased of Mr. Baker, of Holborn, who had agreed to supply it at a price which made it partially a present.

Mr. Beck's Cabinet was accompanied by a letter addressed to the President, in the following terms:

My dear Sir,—I beg to offer for the acceptance of the Royal Microscopical Society a collection of bones and teeth made by me many years ago, when Professor Quekett was preparing for the publication of 'Part II Histological Catalogue.' The collection contains 424 specimens, and is pretty nearly complete. It originally formed part of a collection in our Microscopical Subscription Room, and the slides have on them a monogram, which, however, by a liberal interpretation might be considered to imply Royal Microscopical Society. I am so much occupied in business that I am but seldom able to look at them, and therefore I have ventured to offer them to the Society in the hopes that they may be useful.—Believe me, dear Sir, yours sincerely, Jos. Beck.

A gentleman, through H. Lee, Esq., engaged to present the Society with a complete series of objects, illustrating some special department of microscopy, to the extent of £20, hoping thereby to induce others who may have the means, to aid in fully furnishing the cabinet of the Society.

The following gentlemen were duly elected Fellows of the Society:—Edward Thompson Draper, Arthur Waller, John Wheldon, Alfred Sangster, Wm. Barnett Burn.

Mr. Slack called attention to a microscope which Mr. Crouch, of London Wall, had kindly sent for the Society's inspection. It was a new modification of his "Cheap Binocular," as it was termed in his catalogue, and was fitted up with a very excellent rotatory stage of black glass, slightly modified from the form constructed by Nachet, and which Dr. Carpenter had highly commended. The rotation movement resembled that of Beck's well-known popular microscope. The object-holder was fitted to a glass plate, and moved very smoothly on the glass stage in any direction, being kept in its place by ivory points attached to brass springs, pressing upon it with sufficient force. This form of stage was adapted to all ordinary requirements, but when zoophyte troughs were used it did not give quite enough vertical motion. It was, however, easy to add to the instrument a simple trough-holder, which would obviate the difficulty. The instrument as a whole was well worthy of attention, and decidedly one of the best of the cheaper forms.

Mr. C. Collins introduced a new metallic chimney for microscope lamps, made by him for Mr. Fiddian, of Birmingham. The interior of the chimney is coated with plaster of Paris, and it emits a beautiful white light, in one direction only, through a circular aperture in the metal, to which a flat piece of glass is attached. The combustion appears to be more perfect than it is with the ordinary glass chimneys. The opaque sides of this chimney act as a screen, intercepting all rays excepting those actually required for use.

A paper was read by Dr. Collingwood, F.L.S., &c., "On the Algæ which cause the Colouration of the Sea in various parts of the World." (See 'Trans.,' p. 85.)

A discussion followed the reading of this paper, in which the

President, the Rev. J. B. Reade, Dr. Wallich, and Mr. Hogg joined.

Dr. Wallich was fully able to confirm the valuable observations of Dr. Collingwood, having had opportunities of examining and figuring the organisms referred to during voyages to and from Bengal, in the years 1851 and 1857. Although, in common with Dr. Collingwood, he had never witnessed the blood-red colour, ascribed by some writers to the occurrence of minute algæ in the waters of the ocean, he had on many occasions, during protracted calms, seen the normal clearness modified to a considerable extent, and indeed tinged of a yellowish or greenish-yellow hue by innumerable minute protophytic masses, in some cases consisting of structures allied to the Trichodesmium* of naturalists, in others of true Diatomaceæ. The former occurred in the Bay of Bengal and Indian Ocean, and were met with from 18° N. lat. to nearly 30° S. One form, probably similar to that spoken of by Dr. Collingwood, presented itself in minute spherical masses, about $\frac{1}{20}$th of an inch in diameter, composed of filaments radiating from a common centre, each filament consisting of cells, about twice as broad as long, placed in linear series, and filled with a pale yellowish-green endochrome. The other form occurred in fascicular clusters, like minute bundles of faggots, from $\frac{1}{12}$th to $\frac{1}{20}$th inch in length, compressed or constricted at the centre of the masses, and from the centre spreading out into brush-like expansions. In this variety the surface of the filaments was covered with very delicate hairs, but in other respects the filaments and cells were not distinguishable from those in the spherically-aggregated form.†

The Diatomaceæ alluded to belonged to the genera Rhizoselenia and Coscinodiscus. The Rhizoselenia occurred in dishevelled tufts, varying in diameter from half an inch to an inch and a half, without any regular arrangement, and looking, whilst floating in the water, like flocculent tufts of delicate yellow silk. The individual filaments were of great length, being formed sometimes of a series of from twenty to forty frustules. It was whilst examining these in the fresh and living condition that Dr. Wallich found what he believes has not heretofore been noticed, namely, distinct connecting zones, which were wanting to prove the true diatomacean nature of the Rhizoseleniæ. These connecting zones are extremely hyaline, and require most careful manipulation and lighting to render them visible under the microscope. They embrace the corresponding halves of adjoining frustules, are devoid of all striation, and from their very delicate nature are at once rendered invisible, or become actually destroyed, on submitting the organisms to the action of acids. Another notable character in this Rhizoselenia is afforded by the manner in which

* See the translation of a paper by M. Dareste, published in Vol. III, N. S., 1863, of the 'Societies' Transactions,' p. 1180.

† Both forms are figured in the Volume of Sketches which Dr. Wallich had recently presented to the Society.

the minute claw-like appendage at the apex of each frustule is inserted in a corresponding depression on the bevelled surface of the frustule with which it was in apposition, as if with the view to give additional support at the point of union of adjacent frustules.

From the profusion in which these flocculent masses of Rhizoselenia occur, and their rapid accumulation to a greater and greater extent so long as calms prevailed, it seems probable that at some depth below the surface they may form considerable layers; and this view is further borne out by the fact that the digestive cavities of Salpæ and certain other oceanic Hydrozoa are at times found almost entirely filled with the frustules. On the Atlantic side of Africa Dr. Wallich captured salpæ in chains, numbering from half a dozen to a score individuals, each five or six inches in length, the digestive sacs of which, measuring nearly three quarters of an inch in diameter, were completely distended with this organism only.

Dr. Wallich wished to draw attention to this fact for another reason, namely, that it would indicate the possession by these humbly-organized beings of a power to search for and pick out from amongst a variety of free floating microscopic algæ a particular form; unless it be assumed (which is far from probable) that, having incepted a single frustule, this retains the faculty of growth and multiplication within the cavity in which it becomes imprisoned.

Dr. Wallich invited the attention of those who have opportunities of carrying on microscopic investigations at sea to the influences (whatever they may be) which cause the minute algæ of the open ocean to rise at certain periods to the surface, and again to descend to unknown depths. He suggested that atmospheric pressure, or the more ready transmission of light and heat during calm weather, might produce the effect, but pointed out that the question is still an open one, and well calculated to repay any labour bestowed upon it. To show how little is really known of the extent to which animal life is capable of being carried on under the widely-varying pressures occurring near the surface and at great depths, he mentioned having repeatedly seen large turtle "caught napping" at the surface in the Bay of Bengal, several hundreds of miles away from the nearest point of land, and where the sea was many hundreds of fathoms in depth. These turtle must necessarily descend to the bottom to feed, if they feed at all. He also drew attention to the circumstance that their carapaces were studded with minute living algæ, diatoms, and foraminifera, the latter belonging, in some instances, to sessile families, such as the Miliolidæ.

The Coscinodiscus referred to, and which has been described and figured by Dr. Wallich under the name of *C. Regius*,* is probably the largest known diatom, the frustule measuring $\frac{1}{20}$th of

* One or more mounted specimens will be found in the Cabinet presented to the Society.

an inch in diameter. Like the minute tufts already spoken of, it was met with in countless myriads, during calms, in the Bay of Bengal; its size and the brilliant tint of the endochrome enabling the frustules to be readily observed at a height of several feet above the surface. Two frustules were generally found still adhering together after division had taken place.

Dr. Wallich finally mentioned having, in 1859, seen Coscinodiscus present in great profusion, and under similar circumstances as to weather, around the Channel Islands.

Mr. Hogg thought it a remarkable circumstance that those with large opportunities for making investigations of the curious bodies which give colour to the waters should have seen nothing of "the blood-red colour" spoken of by some authors. Neither was it so certain that Cohn's more recent investigations served to clear up "the mystery" which surrounds similar freshwater colorations, such as Mr. Sheppard's "monad colouring matter." To any one who had the opportunity of making an examination of this peculiar fluid it certainly did not appear quite possible to believe it to be "identical with that which Cohn calls '*phycocyan.*'"

The Rev. J. B. Reade, in proposing a vote of thanks to Dr. Collingwood, alluded to the value of the paper as a record of the personal and accurate observations of the author. Some who have written largely on the subject are indebted entirely to the observations of others, and these being cemented with a certain amount of imagination paste, yield a report of no substantial value. Of such inaccuracies the author justly complains. Mr. Reade referred to a paper in the 'Phil. Trans.' for 1772, by Captain Newbold, of the "Kelsall," who described the appearance of the sea near Bombay as milky white, owing to an innumerable quantity of animalcules, perceptible to the naked eye. He also observed, with reference to the Red Sea, that Dean Stanley states, in his work on Palestine, and as a result of personal observation, that forests of submarine vegetation and red coral reefs gave the whole sea its Hebrew appellation of the "sea of weeds," and that these coralline forests form the true weeds of this fantastic sea.* He referred also to the testimony of the late Captain Newbold, who describes the waters as marked with annular, crescent-shaped, and irregular blotches, of a purplish red, extending as far as the

* In II Book of Kings, chap. iii, an account is given of the rebellion of the Moabites against the reigning kings of Judah, Israel, and Edom. Elisha had received a Divine intimation that though they should not see wind, neither rain, yet that the valley should be filled with water. "And it came to pass in the morning, that, behold, there came water by the way of Edom, and the country was filled with water. And the Moabites gathered all that were able to put on armour, and stood in the border. And they rose up early in the morning, and the sun shone upon the water, and the Moabites saw the water on the other side as red as blood. And they said, *This is blood:* the kings are surely slain, and they have smitten one another: now, therefore, Moab, to the spoil." The Moabites were thus deceived by this appearance and their, perhaps, not unnatural conclusion. They came accordingly to the camp of Israel, and the Israelities rose up and smote them.

eye could reach. They were curiously contrasted with the beautiful aquamarina of the water lying over the *white* coral reefs. "The red colour I ascertained," says Captain Newbold, "to be caused by the subjacent red sandstone and reddish coral reefs. A similar phenomenon is observed in the Straits of Babel Mandeb, and also near Suez, particularly when the rays of the sun fall on the water at a small angle." Pliny speaks of the Red Sea as a vast forest: "Rubrum mare et totus Orientis oceanus refertus est sylvis." Sandstone and granite lend the strong red hue which is connected with the name of Edom. It is described by Diodorus Siculus as of a bright scarlet hue, and is represented in legendary pictures as of a bright crimson. We are thus supplied with sufficient reasons for the colour of the Red Sea without assigning it wholly, as some have done, to red algæ, which Dr. Collingwood never saw. The nature and effect of what he did see is admirably described, and we are greatly indebted to him for his communication.

Dr. Murie read a paper "On the Arrangement and Classification of Microscopic Objects in Cabinets."

The Chairman observed that the views brought forward by Dr. Murie were well worth attention, and would be valuable in assisting the Council to rearrange the Society's collections. He suggested that, as the subject was of a very technical character, and required mature consideration, it might be advisable to postpone any discussion upon it.

The best thanks of the Society were offered to the respective authors of these papers.

Quekett Microscopical Club.

December 27th, 1867.

Mr. Arthur E. Durham, President, in the chair.

Mr. N. Burgess read the concluding portion of a paper on "The Wools of Commerce, Commercially and Microscopically considered."

Mr. Bockett called attention to a form of live-box, in which he exhibited some Acari under a microscope.

Specimens of Stephanoceros, Conochilus, and some sections of wood, were distributed. Eleven members were elected.

January 24th, 1868.

The President in the chair.

Mr. M. C. Cooke read a paper on "The Hair of Indian Bats," which he illustrated with numerous diagrams and mounted specimens which he afterwards presented to the club.

Eleven members were elected.

February 28th, 1868.

The President in the chair.

Dr. T. F. Purley, of U. S. America, was introduced to the

meeting, and he exhibited an American objective of $\frac{1}{15}$ power constructed for use on the immersion principle or otherwise.

Mr. Hislop read a paper entitled "Some Suggestions on Oblique Illumination."

Mr. Draper read a paper "On the Proper Application of the Microscope by Amateurs."

Three members were elected.

March 13th, 1868.

The annual conversazione was given at University College, under the presidency of Mr. Durham, when the entire suite of rooms, comprising the noble library, Flaxman Hall, Shield Room, museum, and a dark room for the exhibition of the oxyhydrogen lantern was thrown open, and a numerous company of members and their friends assembled on the occasion.

Various objects of interest were exhibited by the members. They were well supported by the leading opticians, who vied with each other in the introduction of attractive novelties. Some beautifully-executed photographs, a large collection of diagrams, electric apparatus, fish-hatching contrivances, micro-spectroscopes, stereoscopes, &c., greatly promoted the success of the evening.

Dublin Microscopical Club.

17th October, 1867.

Mr. Archer desired to record and to exhibit some examples of the zygospore of *Closterium costatum* (Corda) for the first time seen conjugated. The zygospore, as for this form might be *à priori* predicated, is large, broadly elliptic, smooth, and placed between the for some time persistent, empty parent-cells, quite like the similar condition of *Closterium striolatum*.

Mr. Archer likewise showed a Closterium new to this country, *Closterium cynthia* (De Notaris), if, indeed, he were right in the identification, which, without original authentic specimens, is, of course, open to some amount of uncertainty; yet at the same time, in the present instance, he did not feel much doubt. This species has only just been published by De Notaris in his 'Elementi per lo Studio delle Desmidiacee Italiche' (p. 65, tab. vii, fig. 71), and it is well distinguished amongst the much curved forms by the cell-wall being striolate, not smooth. It is, moreover, marked by having but a solitary, somewhat large granule in the middle of the terminal space, not a cluster of minute ones. It at once catches the eye by its peculiar curvature, differing from that of the much curved forms at all liable to be mistaken for it; it is not so equally arched, and the ends are more rounded and blunt than in them; in fact, it is not so graceful a form as *C. Leibleinii* or *C. Dianæ*, which it seems most to approach in size; it comes nearest *C. Jenneri* in outline, but is a good deal larger. But from all these, as before mentioned, it differs in being striolate, not destitute of markings. Along with these specimens occurred a variety of other Closteria,

more or less closely related, but all perfectly distinguishable from each other.

Rev. E. O'Meara showed some new diatoms, descriptions of which will hereafter appear.

Mr. Archer exhibited specimens of three seemingly distinct forms of an organism, not any of which are by any means uncommon in moor gatherings, but at the same time seemingly not recorded in this country. One of these seemed to be referable to *Monas consociata* (Fresenius), as figured in his 'Beiträge zur Kenntniss mikroskopischer Organismen,' which Mr. Archer exhibited (Pl. X, fig. 31). This formed minute, but variously sized mucous patches of a colourless, semipellucid, somewhat granular appearance, the substance not forming, however, a uniform mass, but flattened and gradually expanding branches, arranged in a radiate or fan-like manner, sometimes, indeed, almost forming a complete circle. The arms or branches (often several times irregularly divided) more or less expanded, to a certain extent in a staghorn-like manner, from the base upwards, or, if forming a circular mass, from the centre outwards. Immersed within the gelatinous granular substance, and seated close to the upper outer margin or extremity of the mucous branches, occur more or less numerous greenish, uniciliated, monadiform bodies, whose flagella wave about in the water. Occasionally this radiate or ramified appearance of the basic gelatinous substance seemed to be more obscure, and thus was a certain amount of homogeneity and a more uniform appearance produced. And in such instances the resemblance to the figure given by Fresenius is greater. The form here alluded to presented tufts or masses varying in size. The second form shown is of equally pale colour, and is ordinarily far smaller in mass and of an evenly rounded outline, without evident arm-like extensions; the centre of the almost disc-like mass is apparently less dense than the outer portion, and more granular in appearance, and the "monads" are located more evenly and equidistantly from the centre, in an annular manner; and as one looks into the microscope, when present, these organisms render themselves noticeable by this ring-like appearance. The third form drawn attention to is of varying size in the mass, but often seems to reach dimensions not attained by either of the others, and it seems distinguishable from them by its red or brown colour and more dense character; the mass of indefinite figure, often more or less lobed, but without the expanded arm-like or branch-like character of the first. Seated all over the periphery are the "monads." The ciliary motion of the monads in specimens sufficiently small, and thus not impeded by being confined, imparts a, generally indeed very limited, locomotive power to the total "colony." When seen side by side these three forms seemed to offer very tangible differences, but he would leave them for further observation before he would venture to speak more decidedly as regards them.

21*st November*, 1867.

Dr. John Barker exhibited a Chytridium, which, so far as could

be made out, is doubtless a new, and certainly a very distinct, form. This, when first detected, was found growing on *Closterium didymotocum*, but the specimens now presented were upon *Eremosphæra viridis*. This Chytridium, when fully formed, is globose, but beset all round by numerous minute, hyaline, acute, short, spine-like processes, one of these, somewhat longer than the rest, occupying the pole or summit, whilst a few smaller than this, but notably longer as a rule than those irregularly placed over the surface, stand out equatorially; the young cells are without these little spinelets; and when these become first manifested the polar one is the most prominent, and those equatorially disposed lend, along with it, somewhat of a halbert-shape to the growing Chytridium. A root, or mycelium-like process, seems to penetrate into the infested plant. Dr. Barker had not seen the evolution of zoospores. For this seemingly very marked form in this curious little genus he would propose the name *Chytridium spinulosum*.

Mr. Archer desired to place on record the occurrence, for a second time, of *Chytridium Barkerianum*, ejus; and again, from Callery Bog, and, as on the first occasion, growing upon Zygnema. It had occurred exceedingly sparingly; but there could be no doubt whatever but that it was one and the same thing as the form he had first brought forward (see Minutes of 20 Sept., 1866), and a very marked and distinct form in this genus, and seemingly rare.

Mr. Archer likewise desired to record the occurrence of *Cosmocladium saxonicum* in the same gathering from Callery Bog; the first Irish specimens were from near Carrig Mountain. This appears an exceedingly sparing plant when met with.

Mr. Archer exhibited some fine examples of an organism taken from Callery Bog, which he thought he would be justified in identifying as *Synura uvella*, Ehr. This occurred tolerably plentifully along with several other pretty things, such as *Pandorina morum*, a few specimens of *Gonium pectorale*, various Desmidieæ, &c. They formed a very pretty sight, slowly revolving under the microscope. Carter has claimed Synura as some state of development of *Volvox globator*. Quite irrespective of its seeming complete difference in structure, Mr. Archer thought that one very strong argument against that assumption was that the present specimens, at least, were taken from a station (Callery Bog) which had never yet produced *Volvox globator*, and he would venture to hazard a conjecture that it never would be found there. Volvox occurs in the Rocky Valley, some hundreds of feet lower down than Callery; but it certainly has never yet presented itself, after repeated searchings, so high up as the top of the Long Hill. Neither has it ever shown itself in Featherbed Bog. Parenthetically, then, he thought he might put the query, possibly not without its interest—At what elevation does Volvox cease? It does not appear to be an alpine form in its distribution. But further, Synura appears to be quite different in structure from Volvox, and quite different in colour too, being of a yellowish dull colour, in place of a bright herbaceous green. Unlike Volvox, the individual monad-like structures are uni-

ciliated, and they are prolonged below into a slender stipes-like posterior extremity, all these running towards a common point in the centre of the colony. These filiform stalk-like prolongations seemingly divide with every self-division of the bodies at the periphery, being sometimes simply forked, at others divided into four, each upper extremity bearing one of the monad-like structures, thus presenting a certain amount of parallelism with the algal genus Dictyosphærium. Nay, the resemblance is thus greater to Uvella, or even to the forms brought forward at last meeting, one of which was doubtless the same thing as that called *Monas consociata* by Fresenius. The organism now shown, believed to be nothing else than *Synura uvella*, differed, indeed, from *Monas consociata* by the far less dense character of the mucous matrix, and by the tail-like or stalk-like terminations, and by the far more active motion of the total colony. But, notwithstanding these resemblances, the organism now brought forward was clearly, *à priori*, quite a distinct thing *in itself* from either *Monas consociata*, Uvella, or Volvox, or Pandorina, or from the so-called *Sphærosira Volvox;* and it is hard to see how so very distinct structures as the Synura and all these could be evolved the one from the other. It is satisfactory, until further research is bestowed on these organisms, to see that Diesing keeps them separate ('Revision der Prothelminthen,' p. 377), for it does not seem justifiable to consider such forms as Synura as not autonomous merely on suspicion, for whilst volvocinaceous plants without doubt pass through very remarkable phases, Mr. Archer would venture to think that Synura hardly seems truly volvocinaceous at all.

Rev. E. O'Meara reported that certain diatomaceous materials submitted to him for examination by the Club had been investigated by him with the following result:

No. 1, from the Geysers, Iceland, contained several species of Epithemiæ, including *E. Argus*, *E. ocellata*, *E. zebra*, and *E. Westermanii*.

No. 2, fossil earth from New Zealand, transmitted by our corresponding member, Captain Hutton. This material was most interesting, containing peculiar forms of Melosira and Achnanthes in great abundance. Whether these species are new or not, remains for further investigation.

No. 3, from Calcutta. This gathering contains *Pleurosigma reversum* (Greg.) in considerable abundance. The form was described by the late Dr. Gregory in his paper on the Clyde forms. Only four specimens were found by him, and in all cases the striæ were so faint that he was unable to ascertain their character. In these specimens from Calcutta the striæ are distinctly marked and transverse.

Dr. Alexander Dickson exhibited embryos of *Pinguicula vulgaris* and *P. grandiflora*. He pointed out that the embryos of these species agreed in having only one cotyledon, but that they presented marked differences by which they might readily be distinguished from each other. In *P. grandiflora* the base of the single cotyledon almost

completely surrounds the axis of the embryo; while in *P. vulgaris* there is a considerable interval between the two halves of the base of the cotyledon, exposing the extremity of the axis of the embryo or rudimentary plumule. In *P. grandiflora*, again, the extremtiy of the cotyledon is constantly and deeply bifid, while in *P. vulgaris* it is almost constantly entire, Dr. Dickson having only seen two or at most three cases, out of a large number of embryos, where the cotyledon was more or less divided at its extremity.

Dr. John Barker showed examples of a Mallomonas (Perty), probably *M. Plösslii* (Perty), and referred to the copy of Perty's figure given in Pritchard.

Mr. Archer ventured to think there might be two forms confounded in this genus, as the figure given by Fresenius (which fortunately he happened to have brought down with him) agreed much better with Dr. Barker's specimens than did Perty's figure; the latter is stouter and broader, being broadly egg-shaped, whilst that of Fresenius and the present form is much narrower, and might be designated as *oat-shaped*.

Rev. T. G. Stokes exhibited some pretty and interesting Diatoms. He remarked that it was very difficult to grasp the idea that the genera and species of the angular forms of Diatomaceæ did not depend upon the number of angles. He thought that at present, so far as he knew, the basis of induction for this theory was rather narrow, though the curious and bizarre forms of *Triceratium variabile*, throwing out, as they do, angles in every direction, formed a most important link in the evidence. It is no small confirmation of a theory if, assuming it to be true, and arguing from the seen to the unseen, we are enabled to explain known or predict the discovery of unknown phenomena, and that our views are justified by the result. He begged to direct the attention of the meeting to what he believed to be a case of this kind. In October, 1865, the late Dr. Greville published a paper in which he said that he believed the *Amphitetras parallela* of Ehrenberg to be a quadrangular form of Triceratium, although the triangular form had not yet been discovered. Mr. Stokes then exhibited a specimen authenticated by Dr. Greville of the quadrangular form, and a form which he (Mr. Stokes) believed to be truly the triangular form of the same species. Both were from the Moron deposit. Mr. Roper, of London, however, thinks it to be a small form of *Triceratium giganteum*.

Mr. Stokes likewise showed a curious form which was discovered by Mr. O'Meara to consist of two frustules of *Biddulphia aurita*, united by a perfectly transpareut band of silex, leaving a fenestra-like opening in the centre.

December 19*th*, 1867.

Mr. Archer exhibited a Difflugia which occurs in the moors about Carrig and Callery, and yet not very commonly, but which he had long noticed, and would now refer to *Difflugia oblonga* (Ehr.), Fresenius; and he showed the figure given by Fresenius in his useful paper, 'Beiträge zur Kenntniss mikroskopischer Organismen,'

1858. This form seems quite distinct and constant; it is comparatively but a small form, and the test of a reddish or foxy colour, and broadly elliptic figure; the foreign particles are impacted with beautiful regularity, so that the mosaic work presents a very even external surface; there is a short but distinct neck, of a smooth appearance and darker colour, seemingly without particles and undulate at the opening, presenting thus a few shallow lobes. This is a quite distinct looking form, its reddish colour and even outline causing it to be readily detected even under a moderate power.

Dr. John Barker exhibited excellent characteristic examples of the very minute but seemingly very distinct and constant little rhizopod to which he had first drawn attention at the Club meeting February, 1867; but on that occasion he had not a specimen to show. This is exceedingly minute, nearly orbicular or broadly elliptic; from two opposite points there emanates a tuft of filiform pseudopodia; and in the body of the organism is immersed an oil-like refractive globule of an orange or amber colour. The tufts of pseudopodia have been here alluded to as opposite one another, but they are not diametrically so, being always placed slightly oblique to one another. There are, of course, two positions of the organism as regards the observer, when the tufts of pseudopodia might present the appearance of being exactly opposite, but a partial revolution of the organism shows that they are not really so. Dr. Barker showed some examples with the pseudopodia retracted, and their place occupied seemingly by a minute globular, hernia-like, sarcode protrusion; other examples showed neither pseudopodia nor this little globular protrusion, but in their place a little depression, pointing to the existence of a kind of coat or cuticle, with two minute apertures for the emission of the pseudopodia. For this creature Dr. Barker would propose the name of Diplophrys (nov. gen.), and would call it *Diplophrys Archeri*.

Mr. Archer, in reference to Dr. Barker's new rhizopodous form, said that, so far as he could venture to form an opinion, it should be relegated to a new genus, although, supposing it has a test, it might be thought by some to appertain to and form a second species in his own rhizopodous genus Amphitrema. But Diplophrys would be to Amphitrema in some measure as Cyphoderia or Euglypha to Pseudodifflugia (Schlumberger), or as Arcella to Difflugia, which he thought as yet to be well founded as distinct generic types, notwithstanding the views of some that all these are but extreme varieties of one and the same protean rhizopod. Nothing could be more distinct and constant, *per se*, than Dr. Barker's little Diplophrys. Mr. Archer had several times met with it since Dr. Barker first pointed it out, and it was always readily recognisable when encountered, even when its pseudopodia were not extended; but its great minuteness well calculated it to elude observation, unless it accidentally presented itself under a comparatively high amplification.

Dr. Robert M'Donnell exhibited some specimens of the entozoon known as the *Trichina spiralis*, met with in the muscle of man.

Dr. M'Donnell observed that the life history of this worm had been well worked out by German investigators. Existing, suppose, in the muscle of a mouse in what is known the encapsuled state, it remains, and seemingly would always remain, in the larval condition. If this mouse, however, is eaten by a cat, the encapsuled larval Trichinæ get into the intestinal canal, and there grow, and their sexual development becomes complete. They have offspring, which, while still very small, penetrate the wall of the intestine, migrate through the body, and finally take up their abode in the voluntary muscle of the cat, there to remain until it, in its turn, falls a prey to some flesh-eating animal. Dr. M'Donnell exhibited several preparations showing the minute worm coiled up within its capsule in the muscle, and also taken out of the capsule by dissection.

Mr. Archer once more ventured to show *Conochilus volvox*, in fine condition; but this would not be worthy of another record, except to mention that the numerous specimens to be seen were taken from under ice some three or four inches in thickness (during the late brief and sudden frost), which had to be smashed with a heavy stone, after some labour, before a gathering could be made. Moreover, the specimens had been nearly three weeks in the house, whilst sometimes in warmer months they had disappeared ere as many days. As it is sometimes thought that fine objects of interest are not to be had in winter, this reference to this striking rotatorian may not be thought wholly uninteresting.

Dr. Alex. Dickson exhibited the "Protonema" of *Schistostega osmundacea*, showing the curious structure presented by the confervoid filaments giving off here and there a globose cell, which, in its turn, gave off by constriction strings and clusters of similar cells, each eventually cut off from its neighbour by a septum, thus originating an almost fruit-like structure. To the presence of these globose cells, which contain chlorophyll, is due the peculiar green lustre presented by this moss.

Dr. Moore had taken this pretty little moss in Yorkshire, and had it under successful cultivation.

Dr. Dickson further showed the unicellular hair-like roots from the thallus of Marchantia. These were seen to present the remarkable character amongst vegetable cells of possessing a secondary internal deposit, in the form of minute spine-like processes extending into the cell-cavity. It sometimes seemed as if these ran in a spiral direction, and occasionally the whole filament assumed a kind of spiral twisting, to use a familiar illustration, comparable to that of a stick of barley sugar. Dr. Hofmeister mentions a somewhat similar form of deposit in the hairs of the related genus Riccia, as well as Marchantia, to which Dr. Dickson referred.

Birmingham and Midland Institute.

The Second Annual Dress *Conversazione* of this institution was held in the Town Hall, Birmingham, on Wednesday evening, December 4th, 1867. The invitations to this meeting are

issued to those gentlemen only who are annual subscribers to the institute (of whom there are about 1000) and to ladies. The number present was upwards of 1100, and the spacious hall soon after the commencement of the proceedings presented a very animated appearance. We do not remember, in our somewhat extensive experience of provincial microscopical soirées, having before noticed so large a number of people devote their attention solely to the microscopes for the greater part of the evening. Altogether, whether regarding the number of instruments exhibited, their character, or the appreciation of them shown by the company, the success of the display must have been highly gratifying to those gentlemen who have had the care and labour of making the arrangements. One of the gentlemen, on whom a large share of this labour fell (Mr. Thos. Viddian), exhibited and explained the use of the Sorby-Browning microspectroscope. This delicate instrument received a large amount of attention and admiration. Those portions of the floor of the hall which were not available for the display of microscopes, were placed at the disposal of Mr. C. J. Woodward, B.Sc., who had charge of the display of scientific apparatus. There, among many interesting objects, a collection of apparatus including Maxwell's stereoscope and Graham's polytrome, lent by Messrs. Elliott of London, an ice machine in operation, lent by the Wenham Lake Ice Company, a cylinder printing press and a pantograph, both in operation, were exhibited. A lithographic press was kept pretty constantly at work in printing copies of a drawing which had been reduced from its original size by means of the pantograph. Mr. Woodward also exhibited a, to us, novel arrangement for showing experiments with sensitive and singing flames. In the galleries we noticed some beautiful photograms from Dr. Maddox's negatives, a case of exquisite casts from the same by Woodbury's process, and an extremely valuable collection of burettes for the purposes of volumetrical analysis, lent by Mr. J. How of London. Mr. Wheeler showed a large collection of microscopic objects and cabinets. Among its many objects of attraction, a set of models in operation showing Mr. Lewis Jones' method of regulating clocks by electricity formed an interesting exhibition. The remainder of the space in the galleries was occupied by photograms, specimens of drawings produced by the new process of graphotyping, a curious collection of books printed by Baskwills, some admirable stereoscopes and graphoscopes provided by Messrs. Murray and Heath and local makers, and a costly and exceedingly beautiful collection of enamels and jewellery from the respective establishments of Messrs. Elkington and Messrs. Randel, both of which are calculated to uphold the reputation of Birmingham for art metal work.

ROYAL COLLEGE *of* SURGEONS, HUNTERIAN LECTURES *on the* INVERTEBRATA. By Prof. T. H. Huxley, F.R.S. (Abstract.)

Lecture I.—Having treated of the vertebrata in previous courses, there remained for consideration the rest of the animal kingdom known as Invertebrata. Professor Huxley remarked that the line between Vertebrata and Invertebrata was very definite. There are no links leading in any way from any of the great groups of Invertebrata to the Vertebrata. It must not, however, be supposed that the Invertebrata are equivalent as a group to the Vertebrata: they are a much larger and more various assemblage. The Invertebrata cannot be limited so sharply at the other end of the scale, viz., where they approach plants. The higher plants are very broadly distinguished from the higher animals. Plant-cells (using the term "cell" without prejudice) are surrounded by cellulose—a non-nitrogenous substance. No animal cell ever presents this. By this prison-wall of cellulose, all undoubted plants are prevented from exhibiting locomotive processes. For the same reason no plant takes solid nutriment. All the higher plants are manufacturers: they have the wonderful power of uniting carbonic acid, water, and ammonia, to form protein compounds. Plants alone are known to possess this power of making "vital matter." All animals on the other hand (omitting the debateable organisms) exhibit the reverse action of breaking down and using up this vital matter. But when we come to the lowest forms of life, these tests of animality and vegetability fail us. Cienkowski has recently shown that those well-known forms called monads lose their cilium and become amœbiform, taking in solid nutriment like undoubted *animals*. But soon they become enclosed in a cyst of cellulose (by its reactions), and become coloured with chlorophyl. In this stage they are no less undeniably *plants*. The mass enclosed in the cyst breaks up into four or more pieces, which in due time become again the animal-like monad. This case and many similar examples have led many naturalists to abandon altogether the attempt to make a sharp line between plants and animals. Not only do the morphological tests fail, but also the physiological; for many fungi we know require to be fed on organic materials. Professor Huxley believes that opinion has long been tending to this, that Man and the magnolia are but extreme terms of a continuous series. This must by no means be understood as implying development from a common stock; that is quite another question, and does not affect the facts. Other naturalists have proposed a group of neither plants nor animals—a sort of "no-man's land" to

receive the doubtful forms. Ernst Häckel, of Jena, proposes to form such a group with the name Protista. In it he includes the following:—1. Moneres. 2. Protoplasta. 3. Diatomea. 4. Flagellata. 5. Myxomycetes. 6. Noctilucæ. 7. Rhizopoda. 8. Spongiadæ. Professor Huxley spoke most highly of Häckel's recent work on the 'General Morphology of the Organism,' but he could not agree entirely with this grouping of the lower animals and plants. Protoplasta, Noctilucæ, Rhizopoda and Spongiadæ, he considers are certainly animals. Diatomea he regards as plants on account of their mode of nutrition and reproduction. Flagellata (*Volvox Euglenæ*, &c.) have only their lashing cilia in common with animals: the Myxomycetes (fungoid growths occurring on old tan and trees) are more doubtful. Anton de Barry's researches have shown that they have an amœba stage, in which they take solid nutriment; but their mode of reproduction (by spores) places them among plants. Professor Huxley would admit the Moneres alone as intermediate ground: one of these beings, *Protogenes*, described by Häckel, is the simplest bit of living matter possible. It is clear and jelly-like, without any nucleus or contractile vesicle, and actively spreads its pseudopodia over the minute particles it feeds on. Its existence proves the absence of any mysterious power in "nuclei," and shows that life is a property of the molecules of living matter, and that organization is the result of life, not life the result of organization. By using such a group as Protista we only double our difficulty, for we have to define it as well as plants and animals. All our classifications are very transitory, and are almost matters of subjective inclination. The important thing is the facts. You may have three sorts of classification: 1st, *Logical*, which is very useful and desirable, but is artificial; it consists in marking off groups by sharp differentiation. 2nd, *Gradational*, one in which more attention is paid to resemblance than difference, and in which the gradation of forms is exhibited. 3rd, *Genetic*, which is the only one that can be final; in such a classification the relations of the various forms of life in their origin and descent would be exhibited. Professor Hulxey adopts the following grouping of Invertebrate animals:

A. Protozoa.

1, Monerozoa; 2, Protoplasta; 3, Radiolaria; 4, Spongiadæ.

B. Infusoria.	
C. Annuloida.	C. Cœlenterata.
D. Annulata.	D. Molluscoida.
E. Arthropoda.	E. Mollusca.

He thinks a gradation can be clearly pointed out from

the Protozoa through the Infusoria, and succeeding groups to the Arthropoda, whilst a similar gradation is traceable from the Sponges, through Cœlenterata to the Mollusca. The break, however, is very great between Sponges and Cœlenterata. No hypothesis is involved in this: it is simply a matter of fact. The probability of genetic relations Professor Huxley did not propose to discuss.

Lecture II.—The Foraminifera were considered in this lecture. They may be placed as a group among the Monerozoa, containing, as they do, some of the very simplest forms of life. One of the simplest of Foraminifers is *Gromia*—a jelly-like mass, with extensive pseudopodia enclosed in a small horny shell. Some Foraminifers have more or less calcareous matter in place of this horn; and in *Carpenteria*, a very remarkable encrusting form, siliceous spicula exist, leading on thus to the Sponges. Some Foraminifera have an arenaceous shell, built up of particles of foreign matter cemented together, instead of an excreted one, and the arenaceous species exactly repeat in many cases the forms of the calcareous ones. By the aggregation of a number of simple chambers, such as that of *Gromia* or *Orbulina*, a great variety of forms may be produced; and it is in this way that many of the simpler Foraminifers are constructed. If the chambers grow one out of the other so as to leave a space between the adjacent walls of succeeding chambers, we get the interstitial canals of such genera as *Operculina*. If in addition to this the chambers completely enclose their predecessors as they develop—leaving at the same time an interval between the adjacent walls—we get the complicated structure of Nummulina. It is found that the most distinct-looking forms of Foraminifera—helicoid, globular, cylindrical, &c.—run into one another by completely gradated series, and hence the old classification of them by the form of aggregation has been abandoned. Carpenter, Parker, and Rupert Jones have shown the impossibility of drawing such fine distinctions, and in some cases have demonstrated that fifteen genera of D'Orbigny are but varieties of a single "species" or type. The group is now divided, first, into *Imperforata* and *Perforata*, according as the shell-structure is whole or perforated by minute canals, through which the sarcode substance of the animal passes in every direction. The Imperforata includes three families: the *Gromida*, the *Miliolida*, and the *Lituolida*. The Perforata also presents three families: the *Lagenida*, the *Globigerinida*, and the *Nummulinida*. The Gromida, all have a membranous or horny shell; the Milliolida have a porcellanous calcareous shell; the Lituolida repeat the Milliolida forms, but in arenaceous instead of calcareous

substance. The Lagenida are perforate, but present no interstitial canals—the Globigerinida are said to have coarse perforations and interstitial canals—whilst the Nummulinida present perforations and interstitial canals as well as that peculiar mode of growth already mentioned. Professor Huxley, having had occasion to examine *Globigerina* himself, states that he does not find the coarse perforations, but the surface presents a series of prismatic outgrowths which might mislead as to their presence. No distinctions of genera and species can be made at all satisfactorily in the Foraminifera. They present great linked and unbroken assemblages of forms. With regard to geographical distribution, all the larger species are found in the warmer oceans. Their geological distribution is more interesting. In the Laurentian rocks of Canada, below the great Cambrian series, once called Azoic, Sir William Logan found a structure which Dr. Dawson of Montreal had the great courage to declare organic. This was the *Eozoon*, which is fairly proved to be an encrusting Foraminifer, such as *Carpenteria* in its habit, and not unlike Nummulina in structure. In the Lower Silurian beds Ehrenberg detected Foraminifera by internal casts of the chambers of their shells in silicate of iron, which formed a sort of greensand. The shells themselves were dissolved away. In the Trias they are found, and thence abound in all strata to the present time. But in all this series there is no change in structure or in form; the species appear to be identical; in the chalk, at any rate, *Globigerina* abounds, as it does in the grey chalk now found in the bed of the Atlantic. This is an exceedingly significant fact. The bed of the Atlantic is a vast plain, covered by some 16,000 feet of water; the chalky matter now depositing there is made up of Globigerina, curious little bodies which Professor Huxley called Coccoliths, and five or six per cent. of Radiolaria and Diatomeæ. Whence do they come? Professor Huxley believes that the Globigerinæ live and die *at the bottom;* but the Radiolarians float while alive at the top, and sink when dead. Vast deposits are made up in the same way as the bed of the Atlantic. The great Nummulitic formation belonging to the Eocene period stretches from south England to India, and is made chiefly of the remains of the large Foraminifer *Nummulina*. The chalk presents exactly the same species as the Atlantic bed, and Mr. Sorby has detected in it even the little Coccoliths found in the Atlantic sea-bed. The siliceous organisms in the chalk have been in great measure dissolved and redeposited in cracks, seams, and cavities; it is they, in fact, which have furnished the chalk-flints.

OBITUARY.

JOHN HEPWORTH, M.R.C.S.

Died, 28th January, John Hepworth, M.R.C.S., at Croft's Bank, near Manchester, æt. 62, after a brief illness. Three days before he had been explaining a fine celestial microscope to a few friends, and seemed then much in his usual health, complaining, however, of spasms.

He was a pupil of Mr. Jordan, of Manchester; then studied at the Middlesex Hospital; commenced practice in 1827. His published communications all appeared in the 'Quart. Jour. Mic. Sci.' as follows: "On the Foot of the Fly," Vol. II, 1854; two short additions on the same subject in Vols. III, IV, 1855—56; "On the Mandibles of Acari," Vol. IV; "Practical Use of the Microscope" (in Medicine), Vol. V; a more extended article on the same subject, with the title "On Compound Nucleated Cells," in the same year; in Vol. V, N. S., appeared a paper "On the (Microscopic) Structure of the Horse's Foot."

Mr. Hepworth's collection of microscopic objects, most of which were mounted by himself, exceeded in number any other collection in Britain. These are now in the possession of his son, Mr. Francis Hepworth, M.R.C.S., of Eccles.

The use of transparent carmine injection, after the model of the beautiful ones imported from the Continent, had received much attention, and a great deal, both of time and money, had been given to it with fair success.

For some time before his death Mr. Hepworth had devoted much time to the examination of polarized light; he had intended shortly to give the results of his researches to the public. Unfortunately his ideas on the subject are not committed to paper.

Mr. Hepworth was always ready to impart information to those whom he thought capable of appreciating it. His lectures at the Mechanics' Institutions in his neighbourhood were invariably well attended.

He was a man of genial disposition, and a great favourite with all who had the privilege of intercourse with him.

ORIGINAL COMMUNICATIONS.

Nobert's Test-plate *and* Modern Microscopes.

By Charles Stodder.

(From the 'American Naturalist,' April, 1868.)

Every possessor of a first-class microscope wishes to know what his instrument is capable of doing. To the practical worker it is a matter of much importance, for when the utmost power of his instrument is exhausted he will know that it is a waste of time to endeavour to see more. One of the desirable and important properties of a microscope is the power to show or "resolve" very fine lines grouped together, *e.g.* the striation of the frustules* of the Diatomaceæ. For the purpose of testing the resolving power of the microscope, the lines ruled on glass by F. A. Nobert, of Barth, Pomerania, have long been admitted by experts as the best known test, not only in consequence of their exceeding fineness, but also because they are ruled to a known scale, and because they are so close that physicists have asserted that it is impossible that they ever can be seen, Nobert himself being in this category; and all trials of these plates, except those to be herein mentioned, have resulted in failures to resolve the finer lines of these plates.

The Nobert test is a series of groups of parallel lines ruled on glass thus ||||||| ||||||, each succeeding group being finer than the preceding one. Different plates have a different number of groups, ruled to different scales. The one used by Messrs. Sullivant and Wormly ('American Journal of Science,' 1861) has thirty bands or groups, the coarsest having its lines $\frac{1}{1000}$ of a Paris line apart, and the finest being $\frac{1}{8000}$; each group or band being about $\frac{1}{2000}$ of an English inch in width, and the whole thirty occupying a space perhaps a

* A frustule (*L. frustrum*, a fragment) is one of the fragments into which diatoms separate.

little more than $\frac{1}{50}$ of an inch. Now it is a difficult matter for the mind to appreciate such minute divisions of space, yet it is essential, in order to estimate a little of the difficulty of seeing such lines, to form some idea of their minuteness. The average diameter of a human hair is about $\frac{1}{1000}$ of an inch, yet in a space of only one half as great in the coarsest band of the Nobert plate there are seven lines, while in the 30th band there are forty-five.

The plate which I have used in the trials to be detailed was made in 1863. It has nineteen bands, the first being ruled to $\frac{1}{1000}$ of a Paris line, and each band increasing by five hundred, so that the 19th is $\frac{1}{10000}$.

The following table gives in the second column the fractional part a Paris line* between the lines of each band; the third column, the decimal part of a line as marked on the plate by Nobert; the fourth, the number of lines to an English inch; the fifth, the number of the band in a thirty-band plate corresponding in fineness.

	Paris line.	Decimal of Paris line.	Lines to English inch.	Corresponding No. of Sullivant and Wormly's plate.
1.	1-1000	·1001	11,240	1st
2.	1-1500	·000633		
3.	1-2000	·0005	22,480	
4.	1-2500	·0004		
5.	1-3000	·000333		
6.	1-3500			
7.	1-4000	·00025	44,960	
8.	1-4500			
9.	1-5000	·0002	56,200	15th
10.	1-5500			
11.	1-6000	·000167	67,622	20th
12.	1-6500			
13.	1-7000	·000143	78,737	25th
14.	1-7500	—	84,400	
15.	1-8000	·000125	90,074	30th
16.	1-8500	·000117	96,234	
17.	1-9000	·000111	101,434	
18.	1-9500	·000105	107,167	
19.	1-10000	·000100	112,668	

Has human art ever made an instrument capable of rendering lines 112,000 to an inch visible? If not, is it possible to do so? Is there anything in the laws of light which renders it impossible to see lines so close, and therefore

* One Paris line = ·088815 of the English inch.

renders useless the labours of the optician to improve his instruments beyond a certain point? and, as a corollary, is it decided that it will be useless for the naturalist to try to investigate the structure of tissues beyond what the best existing instruments have shown? It must be borne in mind that the power of seeing a single object is not the question, but the power of distinguishing two or more objects nearly in contact. The problem is exactly the parallel of that of the power of the telescope of separating double stars. A brief sketch of what has been done and what opinions on the problem have been expressed by eminent microscopists and opticians is essential to a full understanding of the question.

Professor Quecket, in 1855, asserted that "no achromatic has yet been made capable of separating lines closer together than the $\frac{1}{75000}$ of an inch." "Mr. Ross found it impossible to ascertain the position of a line nearer than $\frac{1}{80000}$ of an inch." "Mr. De la Rue was unable to resolve any lines on Nobert's test-plate closer than $\frac{1}{81000}$ of an inch."

Dr. William B. Carpenter, in his work on the microscope, published in 1856, says, "Even the $\frac{1}{12}$ objective will probably not enable any band to be distinctly resolved whose lines are closer than $\frac{1}{79000}$ of an inch. At present, therefore, the existence of lines finer than this is a matter of faith rather than of sight; but there can be no reasonable doubt that the lines do exist, and the resolution of them would evince the extraordinary superiority of any objective, or of any system of illumination, which should enable them to be distinguished." In his second edition, issued in 1859, Dr. Carpenter repeated the same remarks, but substituted $\frac{1}{85000}$ for $\frac{1}{79000}$, and then added, "There is good reason to believe that the limit of perfection (in the objective) has now been nearly reached, since everything which seems theoretically possible has been actually accomplished." In the third edition, 1862, he again alters the figures to $\frac{1}{84000}$, but adds nothing more.

On the other side the late Professor J. W. Bailey claimed to have seen lines as close together as $\frac{1}{100000}$ to the inch, and Messrs. Harrison and Solitt, of Hull, England, claimed to have measured lines on the diatom *Amphipleura pellucida* as fine as 120,000 to 130,000 to the inch, and expressed the opinion that lines as fine as 175,000 might be seen with proper means.

To determine, if possible, the truth between these conflicting opinions, Messrs. Sullivant and Wormly ('American Journal of Science,' January, 1861) made an exhaustive trial of one of these "marvels of art." They state that the opti-

cal apparatus at their command was ample; it included a "Tolles' $\frac{1}{30}$ objective of 160° angular aperture—an objective of rare excellence in all respects—besides $\frac{1}{12}$ and $\frac{1}{16}$ objectives of other eminent opticians." They were able to obtain an amplification of 6000 diameters. The plate contained thirty bands, as previously mentioned.

"Up to the 26th band ($\frac{1}{78100}$) there was no serious difficulty in resolving and ascertaining the position of the lines; but on this and the subsequent ones, spectral lines, that is, lines composed of two or more real lines, more or less prevailed, showing that the resolving power of the objective was approaching its limit. By a suitable arrangement, however, of the illumination, these spurious lines were separated into the ultimate ones on the whole of the 26th, and very nearly on the whole of the 27th band ($\frac{1}{81213}$); but on the 28th, and still more on the 29th, they so prevailed, that at no one focal adjustment could more than a portion of the width of these bands be resolved into the true lines. The true lines of the 30th band we were unable to see, at least with any degree of certainty.

"These experiments induce us to believe that the limit of the resolvability of lines, in the present state of the objective, is wellnigh established," and they draw the conclusion, "that lines on the Nobert's test-plate, closer together than about $\frac{1}{87000}$ of an inch cannot be separated by the modern objective."

Although the paper of Messrs. Sullivant and Wormly was republished in the 'Quarterly Journal of Microscopical Science,' in London, and might be considered as being a challenge to the opticians and microscopists of Europe to show what they could do in resolving the test-plate, yet no report can be found of any attempts to resolve the lines until 1865, when Max Schultze ('Quart. Journ. Mic. Soc.,' January, 1866) described the Nobert plate of nineteen bands, and gave the results of his trials for resolving them. "The highest set he has been able to define with *central* illumination is the 9th, which is resolved with Hartnack's immersion No. 10, and Merz's immersion system $\frac{1}{24}$. With *oblique* illumination he has not been able with any combination to get beyond the 15th." It will be seen by reference to the table that Schultze saw finer lines than Sullivant and Wormly. This is the only report we can find in print from Europe.

In this country we find no published results; but Mr. R. C. Greenleaf, of Boston, and the writer were well satisfied that they saw the lines 90,000 to the inch with a

Tolles' $\frac{1}{5}$ in 1863, and the next year Mr. Greenleaf saw the same lines, unmistakably, with a Tolles' $\frac{1}{15}$. Dr. J. J. Woodward, of Washington, in a communication to the 'Quarterly Journal of Microscopical Science,' London, October, 1867, p. 253, states that with monochromatic light, and Powell and Lealand's $\frac{1}{50}$, $\frac{1}{25}$, and $\frac{1}{10}$ objectives, a Hartnack immersion, No. 11, and a Wales $\frac{1}{8}$, with amplifier, he satisfactorily resolved the 29th and 30th bands of Nobert's test-plate. In a letter to the writer written since, Dr. Woodward informs me that the plate used was the *same one* used by Sullivant and Wormly, as the 30th band was the finest on that; the result did not show that finer lines could not be seen. Dr. Woodward informs me that, since writing that paper, he has received a Nobert plate with the nineteen bands, and that the covering glass was too thick for the $\frac{1}{50}$ objective, but with all the others he was able to resolve the 17th band (101,000 to the inch); the 18th and 19th he was unable to resolve. Dr. Woodward has sent to me a photograph of the 16th, 17th, 18th, and 19th bands, taken by Dr. Curtis with the Powell and Lealand $\frac{1}{25}$. In the photograph the lines of the 16th and 17th bands may be counted with some difficulty, but if the whole band is copied, or if the bands are of the width of $\frac{1}{2000}$ of an inch, there are not lines enough. The lines of the 18th and 19th bands cannot be counted in the photograph. From this it will be noticed that Dr. Woodward has resolved *finer lines* than any other observer had yet seen, so far as report gives us any information.

My esteemed correspondent, M. Th. Eulenstien, of Stutgard, Wirtemberg, writes to me, under date of Dec. 17th, 1867, "I have myself resolved the 14th band with a $\frac{1}{12}$ Powell and Lealand, and also, but less unmistakably, with No. 11 Hartnack's immersion, with oblique light." "Nobert himself has never seen with his highest powers higher than the 14th." "This will show you the Continental state of affairs." Mr. R. C. Greenleaf and myself have lately tried several objectives, and the result is appended below.*

* Wales' $\frac{1}{8}$ ang. ap., 140°, B eye-piece, power 475 diam., sunlight oblique . . . . . 8th band.
Hartnack's immersion No. 10 = $\frac{1}{14}$, ang. ap. 155°, power 1062, B eye-piece, light oblique . . . 10th „
Nachet's immersion No. 6 = $\frac{1}{12}$, B eyepiece, sunlight oblique . . . . . 8th „
Nachet's immersion No. 10 = $\frac{1}{21}$, B eye-piece, sunlight central . . . . . 9th „
Nachet's immersion No. 10 = $\frac{1}{21}$, B eye-piece, sunlight oblique . . . . . 12th „

With Tolles' $\frac{1}{0}$ immersion, angular aperture 170°, B eye-piece, power 550, Mr. Greenleaf and myself both saw the 19th band satisfactorily. Thus being probably the first ever to see lines of 112,000 to the inch, and establishing the fact of the visibility of such lines, contrary to the theory of the physicists. (It should, however, have been mentioned in the proper place that Mr. Eulenstien says that Nachet claims to have seen them by sunlight recently, which claim needs some confirmation, as his No. 10 failed so completely in my hands.)

In the present month (January, 1868), Dr. F. A. P. Barnard writes to Mr. Greenleaf, that he had tried several objectives, naming a Spencer $\frac{1}{20}$ and $\frac{1}{12}$, a Tolles' $\frac{1}{10}$ and $\frac{1}{3}$, a Wales $\frac{1}{4}$, and a Nachet immersion No. 8, equal to a $\frac{1}{15}$. "The Spencer $\frac{1}{20}$ and the Nachet $\frac{1}{15}$ broke down at about the 11th or 12th band. With the Wales $\frac{1}{4}$ I got as far as ten, or perhaps eleven bands. With the Tolles' $\frac{1}{3}$ I made out distinctly ten."

In another communication he says, "The highest band I can count is the 16th." In a more recent letter to the writer Dr. Barnard gives the count of the lines on a portion of his plate, corresponding as nearly as could be expected to figures given in the table up to the 14th; but the 16th band he could not count satisfactorily, different attempts giving varying results. It has been said that the resolution of the lines to the eye implies the ability to count them, but this I think is a fallacy; a few lines of a group may be counted correctly, and then it becomes difficult to identify the line last counted and the one to be counted next. Let any one try to count the pickets in a fence, when the pickets are distinctly visible, say at a distance of 100 or 150 yards, he will find this difficulty almost insurmountable. In the microscope the micrometer is an aid in counting, but in counting lines of such exquisite fineness either the micrometer or the stage must be moved, and it is next to impossible to construct apparatus that can be moved at once $\frac{1}{100000}$ of an inch and no more. It would require the genius and skill of Nobert himself to do it.

These trials show conclusively that it is not the great

Tolles' immersion $\frac{1}{10}$, ang. ap. about 160°, B eye-piece, power about 800, sunlight central . . .	8th band.
Tolles' immersion $\frac{1}{10}$, ang. ap. about 160°, B eye-piece, power about 800, sunlight oblique . . .	12th ,,
Tolles' immersion $\frac{1}{10}$, ang. ap. about 160°, B eye-piece, petroleum, light oblique	12th ,,
Tolles' immersion $\frac{1}{10}$, on another occasion I saw the .	15th ,,

power of the objective that is important (for in many of the trials here reported the lower powers have given the best results, and the Tolles' $\frac{1}{6}$ immersion the best on record), but it is the skill of the optician in making the instrument.

Mr. Greenleaf has just tried (February 7th) an immersion objective by Wales' $\frac{1}{15}$. He resolved the 10th, 11th, and 12th bands perfectly; the 13th was doubtful. Another trial of the Hartnack No. 10 resolved the 13th band perfectly—the 14th doubtfully.

I have since tried the Wales' objective *dry*, and resolved the 13th band well, thus doing what Mr. G. did with it in water; the inference must be that Mr. G. did not obtain its best work.

NOTE.—Since the foregoing was written Dr. Barnard has made more trials, and I am well satisfied that he has seen the 19th band with a Spencer $\frac{1}{12}$ and Tolles' $\frac{1}{5}$, *both dry objectives*. This performance fairly surpasses anything yet done, either in this country or Europe. Dr. Barnard writes (Jan. 29), that he found that the counting of the lines was attended with the very difficulties referred to above, in addition to which there is another trouble, the whole width of a band is not in perfect focus at once; this necessitates a slight change of focal adjustment, and any change renders it extremely difficult to fix, even with the cobweb micrometer, the exact line last counted. He made five counts of the 19th band with the $\frac{1}{12}$, namely—

1.	110,392	to the	English inch.
2.	108,270	,,	,,
3.	113,737	,,	,,
4.	106,226	,,	,,
5.	115,474	,,	,,
Mean,	110,820	,,	,,

The number, according to Nobert, is 112,668. He counts for the 15th, 91,545; Nobert, 90,074. Though there is apparently considerable discrepancy between the count and Nobert's figures, yet I consider it as near as can be reasonably expected when all the difficulties are appreciated. Besides, it must be remembered that Dr. Barnard gives as above the number of lines to an inch, not the number actually counted. The actual number in the 19th band should be 56·5, if the band is *exactly* $\frac{1}{20000}$ of an inch, a variation of two lines each way covers the extremes of his counting.

English and American opticians name their objectives (*i. e.* the lens or lenses placed next the object, that next the eye being the eye-piece) from their magnifying power—thus a $\frac{1}{4}$ inch objective has the same power as a simple lens of $\frac{1}{4}$ inch focus. Continental European makers generally distinguish their instruments by numbers, the higher numbers indicating higher powers; but as each maker has his own system, the actual power of an instrument must be ascertained by trial. Instruments also often differ from their names, and they cannot generally be depended on. The theoretical power of a microscope is measured from an arbitrary standard of ten inches—thus, a one inch is said to magnify ten diameters; a $\frac{1}{4}$ inch, forty diameters. If the standard is taken at five inches, as it is by some, then the "power" is but one half as much. The "power" of the *microscope* is that of the objective multiplied by that of the eye-piece; if the objective magnifies ten diameters, and the eye-piece ten, the result is one hundred diameters.

Angular aperture is the angle in the surface of the front lens, at which light will enter the objective—the greater the angular aperture, the more light, and usually the greater *resolving* power.

An *amplifier* is an achromatic combination inserted in the compound body of the instrument to increase the "power" of the objective and eye-piece.

Immersion lenses have lately attracted great attention, though they were made by Amici many years since. The objective is immersed in water—that is, there is a film of water between the front of the objective and the object, or the thin glass covering it. The effect is a great increase of light, and better definition.

New Species *of* Diatomaceæ.

By F. Kitton, Esq.

In the previous number of this Journal, the Rev. E. O'Meara has charged me with carelessness, and thinks if I had read his papers with greater attention I should have expressed my doubts of the genuineness of his new species more cautiously. I have, therefore, read them again, in order to apologise for any misrepresentation, and correct any errors. I find two or three mistakes; viz., *Cocconeis divergens* should have been *C. clavigera*, the remarks on *Navicula pellucida* ought to have preceded the passage quoted by the Rev. E. O'Meara. I have also inadvertently made him the author of *Raphoneis liburnica*, whereas he is only responsible for the variety. With these exceptions, I really find nothing to retract. At page 91, the Rev. E. O'Meara says: "How inapplicable are some of Mr. Kitton's observations on dredging to the forms found by me in the dredgings from Arran." I find, on referring to his first paper, he says, "this material was procured from depths varying from ten to thirty fathoms," &c. I do not think, therefore, I was unjustified in assuming that his material was similar to others procured from like depths, and which, in almost every case, consist of sand, animal and vegetable *débris*, and valves of diatoms. My copy of the 'Microscopical Journal' in which his first paper appears has no description of the figures. I therefore assumed that the figures were magnified 600 diameters, as that was the degree of amplification more frequently used in the second paper. I do not find the number of diameters stated in the text. If the Rev. E. O'Meara refers to the text of his first paper, he will find *Navicula pellucida* is fig. 2; and fig. 2 in the plate is the form which, I think, resembles *Navicula pandura* much too closely to entitle it to rank as a new species.* *N. denticutala* is fig. 3 in text. I am still unconvinced of the specific distinctness of *Surirella pulchra* and *S. gracilis*, or that they differ sufficiently from *S. lata* to warrant their separation from that species. I am willing to admit that a remarkable difference exists between the *figures* of *S. pulchra* and *S. gracilis*; viz., the crenulate margin; alæ are also wanting, but as these differences are not noticed in the text, I am inclined to doubt the correctness of the figures, and

* *N. denticulata* of the text is frequent in the so-called "Corsican moss."

suppose the crenulations represent the undulations of the alæ, and that the margin of the valve is not shown in the figure.

Mr. Roper, at page 17, vol. viii, of this Journal (*Campylodiscus productus*), says: "The markings and canaliculi on most species of Surirella are subject to considerable variation, and afford no good grounds for specific distinction." Professor W. L. Smith, who has long studied the habits of living diatoms (quoted by Dr. Lewis in his valuable paper on "Extreme and Exceptional Variations of Diatoms"), says: "When I find *Navicula amphirynchus* congregating, and producing *Navicula ferma, Stauroneis gracilis* producing *S. Phœnicenteron,* and *Surirella splendida S. nobilis,* quite different in form and striation, I cannot but doubt the propriety of making new species out of every different FORM AND MARKING."

Eupodiscus excentricus I still refer to *Coscinodiscus minor** of Kutzing (not of the synopsis), and, after a careful examination of many specimens from various localities, I find the excentric areolation precisely as figured by the Rev. E. O'Meara, and in he majority of cases a circle of obtuse spines may be easily seen. I do not, however, find any with what I suppose to be an abnormal marginal development, as shown in *E. excentricus.*

The Rev. E. O'Meara says, that a careful consideration of the figures and descriptions of *Raphoneis Jonesii and R. Moorii* would convince that Mr. Kitton's opinion, that they are identical, is untenable. "The sculpture in the two forms exhibits a greater diversity in structure than is considered sufficient in other forms to mark diversity of species." I have carefully compared the figures, and to me the sculpturing seems to be precisely the same in both forms; take away the margin, and it would be impossible to distinguish one from the other. I saw that the description did not accord perfectly with the figure, but as it was nowhere stated that the figure was erroneous, I had no means of knowing which was correct. The suggestion that *Raphoneis Archerii* might be the upper valve of *Cocconeis clavigera* is not so difficult to comprehend when the structure of the genus Cocconeis is understood; the difference between *Raphoneis Archerii* and *Cocconeis clavigera* is not greater than that between the upper and lower valves of *Cocconeis Grevilli.*

Stauroneis rhombica, n. sp., O'M., appears to resemble *Stauroneis apiculata* of D. Greville (in 'Edinburgh New

* This may possibly be the small form of *C. excentricus* figured in the 'Synopsis.'

Philosophical Journal,' July, 1859) much too closely to warrant its separation from that species.

The Rev. E. O'Meara remarks, "that our department of science has been embarrassed by an excessive nomenclature must be obvious to every experienced observer. The evil is traceable in some considerable degree that the descriptions of species are not as comprehensive as might be." Surely the reason why they are not so, obviously arises from the circumstance of so many new genera and species being constituted from unique or rare specimens, and until the system of making new species of scarce forms is abolished, this evil will continue. Before a species can be correctly described, it is necessary to see it in a living condition, and, if possible, its sporangial form. A botanist, before he published a new species, would require to see more than a few leaves. In conclusion, I venture to quote two or three authorities whose opinions are of infinitely greater weight than mine.

Dr. Berkeley (in the preface to his 'Cryptogamic Botany') says: "So long as essential characters are neglected, and fleeting external characters put in their place, difficulty must needs exist, and the student will never be certain that he has come to a correct decision till he has seen an authentic specimen, or compared his own with that of other botanists, as manifested in extensive herbariums. A state of uncertainty is always one of more or less pain, and the temptation to a solution of the difficulty by the supposition that he has made a new discovery present such attractions as to appear insurmountable. Nor will he find it possible, without that mental discipline which arises from a patient study of every detail of structure, and of the various shapes which organs may assume under different circumstances. The great point in all cases is never to describe from single or imperfect specimens, where there is some form evidently very closely allied. A proposer of bad, ill-defined species is no promoter of science." Another acute observer (Dr. G. A. W. Arnott), whose knowledge of diatoms is perhaps superior to that of any other observer of those forms, says, in his paper on "Rhabdonema" (vol. vi, p. 87, of this Journal), "That it is better not to publish a new species, or give it a name, than to do so from scanty or imperfect material, which leaves both genus and species doubtful. Even now I have some hesitation in writing on the subject, as my views are diametrically opposed to those who consider it necessary to give names to forms which to the eye appear distinct, but which have not structural differences sufficient for

a specific character; and this alone entitles them to be acknowledged and referred to by others." And again, at page 106, "Microscopical differences are by themselves of little importance. To see is one thing, to understand and combine what we see is another. The eye must be subservient to the mind. Every supposed new species requires to be separated from its allies, and then subjected to a series of careful observations and critical comparisons.

"To indicate *many apparently* new species is the work of an hour; to *establish* only *one* on a sure foundation is sometimes the labour of months or years. A naturalist cannot be too cautious. It is better to allow diatoms to remain in the depths of the sea, or in their native pools, than, from imperfect materials, to elevate them to the rank of distinct species, and encumber our catalogue with a load of new names, so ill defined, if defined at all, that others are unable to recognise them. The same object may be more easily obtained by attaching them in the mean time to some already recorded species, with the specific character of which they sufficiently accord. In all such cases, the question to be solved for the advantage of naturalists is not whether the object noticed be a new species, but whether it has been proved to be such, and clearly characterised."*

Dr. Carpenter, in the preface to his introduction to the 'Study of Foraminifera,' says: "But nearly a parallel case, as regards the first of these points (the derivation of a multitude of distinguishable forms from a few primitive types) as presented by certain of the humbler groups of the vegetable kingdom, in which it becomes more and more apparent from the careful study of their life history—not only that their range of variation is extremely wide, but that a large number of reputed genera and species have been created on no better foundation than that afforded by transitory phases of types hitherto only known in their state of more advanced development." "And the main principle, which must be taken as the basis of the systematic arrangement of the groups of Foraminifera and Protophyta, that of ascertaining the range of variation by an extensive comparison of individual forms, is one which finds application in every department of Natural History, and is now recognised and acted upon by all the most eminent botanists, zoologists, and palæontologists."

* Since the above quotation was written, I have to deplore the loss of my old friend and correspondent,—a loss that will be acutely felt by all who have had the pleasure of corresponding with him. He was at all times most willing to assist the student with information and specimens..

If my previous paper was wanting in courtesy, as the Rev. E. O'Meara seems to think, I can only say that it was unintentional, and beg to apologise for it; my only desire was to protest against the addition of so many "new species," their claim to that position (in my opinion) being more than doubtful. I could, if I thought it desirable, publish a score or two of new species, if the fact of their *appearing* different to any hitherto published is all that is necessary to constitute a new species.

Microscopic Illumination.

By Edwin Smith, M.A.

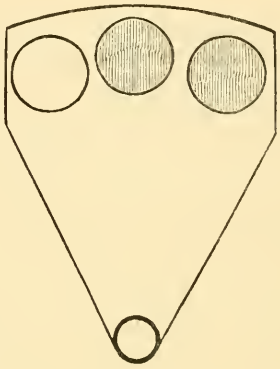
It is often difficult to obtain an equally illuminated field for both eyes when a half-inch object-glass is employed with the binocular. The prism causes the field to be darkened on opposite sides for the two tubes of the body. This defect becomes more apparent when the lenses of the object-glass are further separated from the prism by the additional thickness of the nose-piece. Diffusing the light with ground glass partly remedies the defect, but not entirely; moreover, diffused light is not suitable for many objects, where definite shadows are desired for the purpose of displaying structure. I find, however, that an achromatic combination with wide aperture as condenser, and a half-inch mounted in short cells, completely satisfy the conditions of the problem, and I am now able to employ the half-inch binocularly with perfect ease, by night or day.

Double diaphragm.—To the single diaphragm with which my Webster's condenser is provided, I have added a second plate, revolving close behind the former, and perforated with various stops. By having a large opening in each plate, the stops of either can be brought into play at the choice of the operator, giving a vast range of modifying power, both for dark-ground and transparent illumination. I find the double diaphragm so exceedingly convenient that I wonder it is not always supplied by the makers, the additional cost being a mere trifle.

Exclusion of incident light.—When viewing transparent objects it is generally important to shade off the incident light. For this purpose I have found much satisfaction in the use of small blackened cardboard tubes, made to slide

easily and firmly on the end of the object-glass, their length being adapted to the focus and form of the latter. When brought down upon the slide under examination, they slip back readily to allow of adjustment, and completely exclude light from the upper surface of the object.

Light-modifier.—Some apparatus attached to the microscope is required for the purpose of diffusing and purifying light. It should admit of easy change from one kind of modification to another during the examination of an object, and without having to withdraw the eyes. The following contrivance suggested itself to me, and answers the purpose extremely well. Cut a sector of a circle of convenient size out of a piece of sheet brass, and make three holes, centred on



the circumference of a circle concentric with the first, a short distance apart, each hole equal to the largest aperture of the diaphragm of the microscope. Fit a short slit tube at the angular point, at right angles to the plate, and having its central axis passing through the centre of the larger circles first mentioned. The tube should fit closely on the round stem of the body-support beneath the stage and above the mirror. Be careful to take the radius of that circle which passes through the centres of the three holes, so that when the plate is moved from right to left, or *vice versâ*, each hole shall in turn coincide with the large aperture of the diaphragm. Solder three rings exactly round the three holes, a little larger than they, to form a ledge for the reception of the glass circles next to be described. Let in and secure, with gold-size or other cement, three circles of plane glass; one white ground, for diffusing ordinary daylight; a second neutral tint ground, for diffusing lamp-light or strong sun-

light; a third neutral tint, not ground, for use when the light has to be purified or subdued, but not diffused. The advantage of being able to bring any one kind of modification into play during an observation is great, whilst being always at hand the apparatus is likely to be employed, to the immense comfort of the observer, especially by artificial light.

Lamp-light may be diffused by means of a small globe. The following plan, however, has certain advantages. Grind *one side* of the chimney itself at its lower part near the flame, which may easily be done with a piece of wetted sandstone. A strongly illuminated area of small extent is thus available as the source of light, when the breadth of the flame is not sufficient; while, by half a revolution of the chimney on its support, the uncovered flame may be instantly substituted whenever it is to be preferred.

Experiments *on* Young Salmon.*

By W. C. McIntosh, M.D., F.L.S.

Early in 1862, and in the winter of 1862-3, the development of numerous salmon ova was observed, and some experiments performed on the young fish. Unfortunately, these had to be laid aside in March, 1863, for more pressing engagements, with the intention of again resuming them on a favorable opportunity; but since this has not occurred, the results—such as they are—are now briefly narrated. I may likewise state that during the progress of the experiments much valuable advice was kindly given by Prof. Christison, some of whose experienced suggestions were not fully carried out, on account of the sudden interruption of the work.

The transparency of the young fish renders the central organs of the circulation, as well as the minutest capillary, equally visible, thus affording a much better subject for the examination of irritants and other poisons than the web of a frog's foot, since only a limited area of the vascular system in the latter case can be observed by the experimenter, and better than can be afforded even by the very young tadpole.

The most numerous experiments were those performed with *Fleming's Tincture of Aconite*. The doses of the drug

* Extracts from this paper were read at the meeting of the British Association last year at Dundee (Sept., 1867).

were added to a vessel containing two drachms of water, and the chief features of its action were similar in all cases. The young fish experimented with were from two to six days old.

In the healthy animal, before adding the poison to the water, the action of the heart is quite regular, the contraction of the ventricle (*a*, Pl. III) succeeding that of the auricle (*b*) in a methodical manner, and varying from 70 to 100 per minute; the pectoral fins are also kept in rapid, whirring motion. In a few seconds after the addition of the aconite the young fish showed symptoms of uneasiness, darting round the vessel, jerking its head, and twitching its body and tail. The violent exertions of the animal increased the frequency of the heart's action, and caused congestion of both cavities; but for a time the action of the organ was rhythmical. Before the expiry of ten minutes, however, it could generally be observed that there was a tendency to irregular action of the heart, both cavities occasionally contracting at once. The respiratory movements, as evinced by the action of the lower jaw, became very hurried, but the flapping of the pectoral fins was slower. In about a quarter of an hour the animal does not respond to irritation, unless the dose has been very small, pressure on the yolk-sac only causing a slight twitch. A diminution in the frequency of the heart's action was noted in some at this time. A very remarkable symptom now appeared, viz. a tendency to a more rapid motion in the auricle, with a retardation ofthe ventricular movement, and this became more marked as the paralysis of the muscles of voluntary motion increased.

When a single minim of the tincture was added the increase of auricular and diminution of ventricular action appeared more slowly, generally within an hour, at which period, *e. g.*, the beats of the auricle in one instance were 124, those of the ventricle 62. The auricle resembles a circular caoutchouc bag in a state of rapid contraction and dilatation, while the ventricle retains its shape, but is less vigorous than in the normal animal, especially, in some instances, as regards every alternate contraction. Complete paralysis did not ensue with such small doses for a long time, though the fish kept its body motionless, the pectoral fins being in rapid vibration, and the respiratory movements of the lower jaw very hurried. This state continued for many hours, the jaw moving 160 times in a minute, and the pectoral fins resembling the rapidly vibrating wings of a butterfly or humming bird. This vibratory action now and then became intermittent; but the animal gradually loses the power of responding

to stimuli, fins and jaw become motionless, the current in the caudal capillaries (*c*) fails, and the *vis a tergo* in the veins is little marked (these being evidently affected by the cardiac impulse); yet the auricle goes on pulsating twice for each ventricular contraction, and throws two rapid jets into the ventricle before the latter contracts. Animal life is in abeyance, with the exception of the heart and the larger blood-vessels. The current of blood in the cardinal vein (*e*) (great subvertebral trunk) seemed quicker in some than that of the aorta (*f*), and the minute branches (*f'*) of the latter had also a swifter current than their parent trunk.

In one instance, after two hours' immersion, and the occurrence of the usual results, viz. the doubling of the auricular action as compared with the ventricular, and the general retardation of the circulation, two minims more were added to the water, with the effect of considerably improving the circulation in the vessels of the tail, yolk-sac, and other parts, apparently because the heart's action, though slower, became more regular. The streams sent out of the ventricle were now uniform, and, not as before, alternately full and thready. In a normal specimen the pulsations amounted to 90, whereas in this they were 95, but the heart of the latter appeared to have little more than half the amount of blood. This state, however, is only temporary, as in twenty minutes the auricle again beat twice as quickly. When this condition is gradually induced the vitality of the central organ is great, the contractions continuing for ten or twelve hours in water rendered milky by the poison; and at the end of that period a distinct increase in the frequency of the pulsations is noticed after a fresh addition of the tincture. If the water, however, be poured off, and a few drops of the tincture applied to the animal, the action of the heart at once ceases, and every vessel remains paralysed and full of blood-discs. The body and yolk-sac also rapidly become opaque.

After remaining for many hours in the state in which the ventricular contractions are but half the auricular, the blood does not distend the latter cavity to its normal size, and there is a white border apparent, while its contractions do not quite empty it of blood. The ventricle again shows a large, pale, muscular border, a diminished cavity, and sometimes irregularity in the currents sent along the bulbus. Symptoms of partial recovery now and then appear after small doses, such as twitchings of the tail and slight wrigglings, but these gradually pass off, and the animal remains motionless. Some survived for two days, though neither cavity of the heart contained much blood, and the proportion of the

auricular and ventricular contractions remained as before. Though the young fish were placed under running water, little alteration ensued at this stage. On the third day, in some, the auricle was still contracting, while the ventricle was almost undistinguishable on account of its pallor. The auricle begins its contraction at the *bulbus venosus* first, and then a rolling, spongy, squeezing motion creeps over all the cavity. Though the auricle was thus filled and contracting with moderate force, I could not see any blood passing into the ventricle, so that the quantity must have been small; and though the vitelline vein (*g*) showed motion, it was mere oscillations of the blood-discs backwards and forwards, without any actual progress, and the same was true of the brachial arteries. In regard to the gradual stoppage of the current in the blood-vessels, long before arriving at the state of exhaustion just described the capillary trunks (*c*) are observed to be stagnant in the tail, as well as many of those in the yolk-sac, while the current in the vessels of the trunk, and in the curving vessels (*h*) of the pectoral fins, continues in the apparently dead animal. They gradually cease from without inwards, until mere oscillation, and finally stasis, occur in the aorta and larger veins.

When a large dose (from six to ten minims) is added to the water, the symptoms are much more boldly marked. After the first turgidity of the cardiac cavities during the violent motions of the animal, the pulsations become slower, retaining, however, for a time, their regularity. They (pulsations) steadily decrease in frequency, *e.g.* from 105 to 22 per minute, the ventricle occasionally missing a contraction, and the action of each cavity in the latter case being indistinctly double. The aortic stream moves in slow jerks, the vein in a more continuous current; only at the end of the arterial stasis it halts, and again proceeds as the fresh arterial impulse reaches it. This happens in about a quarter of an hour in the case of the highest dose (ten minims), and the animal becomes completely paralysed. If the dose is rather less (six minims), some interesting features may be observed in the heart's action after half an hour's immersion. In this case and at this time the ventricular action has fallen behind the auricular (vent. 78, auric. 88, per minute), and every now and then, on account of the non-rhythmical action of the heart, the two contractions are simultaneous, thus causing an arrest of the cardiac action; for the auricle contracting when the ventricle is distended finds no cavity to pump into, and only crams an already full cavity, and prevents its contraction. The fault, doubtless, is primarily in the ventricular

fibres, for after the cavity is filled by the rapid jerk of the auricle it does not immediately contract, and is thus thrown back a beat. This is especially observed after the auricle has gained greater frequency of action. Occasionally there was marked jerking of the arterial system, very well seen in the branchial coils (*i*), and indeed throughout. The blood in the aorta appears of a deeper red than that in the vein, but this is probably due in some measure to the thickness of its coats, since the vein becomes about as dark when it passes beneath the muscular bands.

When the animal has been reduced to a state of complete paralysis by a large dose it may sometimes be seen that the ventricle contracts only at wide intervals, while the auricle may be pulsating 68 to 70 times per minute. The auricular jet scarcely reddens the ventricle, and several are required before the cavity is tinged in the centre; then the ventricle contracts. Four, five, or even seven, contractions of the auricle ensued before the ventricle acted. In one case it was seen that only every second beat forced the blood through the auriculo-ventricular opening. The blood in the early stage of the dilating ventricle assumed a Y-shaped outline, with the fork directed posteriorly; but after a few more auricular beats this became lost in the general red. In these and other instances in which the ventricle is filled with blood, and just before contracting, it may be observed that processes dip here and there into the whitish walls of the cavity, showing that even in this early stage the chamber contains muscular bands with interspaces.

If the action of the heart be quickly reduced to 22 by a powerful dose of the poison, and the animal removed to running water, the pulsations in some become regular and increase in strength, and the circulation throughout the body improves; but before reaching the stage in which the auricular action is twice as frequent as the ventricular an intermediate state occurs, in which a pause takes place every sixth or seventh beat.

When the fish experimented with is older, and the yolk-sac well absorbed, a very small dose (scarcely a minim) creates urgent symptoms, such as immediate irritation, rapid respiratory movements, gasping, violent muscular tremors, retardation of the circulation, gradual diminution of blood in the heart, loss of voluntary motion, and death. Minute observation, however, in such instances is difficult, on account of the opacity of the animals.

The muscles of respiration were paralysed in common with the others, yet one could scarcely attribute death to this

alone, and they certainly were much stimulated at the beginning. The increase of the auricular and the diminution of the ventricular action were independent of the respiratory process, as I have seen the latter in full action, while the ventricle contracted only half as frequently as the auricle. The action of the poison on the ventricular fibres is peculiar, yet, though produced in a circuitous manner, it is analogous to that on the ordinary muscles.

Tincture of digitalis, in doses varying from three to seven minims in two drachms of water, first causes symptoms of irritation, the animal darting vehemently round the vessel, and wriggling convulsively. If the dose is small the rapidity of the heart's action is for a time increased during the period of excitement; and the respiratory movements of the lower jaw are likewise very rapid, indeed in some instances so rapid that they would seem to be ineffectual or impede respiration. According to the strength of the dose, in ten or fifteen minutes the cavities of the heart become loaded, the pulsations much diminished in frequency and irregular, the contractions falling, perhaps, from 110 to 60, and even lower.* There is a decided failure in the power of the ventricular contractions, and the cavity seldom empties itself completely. Moreover, shortly after this it could often be observed that both cavities contracted at the same time, unless the dose was minute, *e. g.* a single minim, in which case the contractions were slightly alternate. Coincident with the retardation of the heart's action is loss of power in the voluntary muscles and the diminution of respiratory efforts in the pectoral fins and jaw. After a time the auricular action is more vigorous and sharp than the ventricular, the latter being somewhat distended. The action of the heart gradually grows feebler, and generally ceases in about an hour; and even with a dose of only one minim death occurs within an hour and a half.

A probe was dipped in *creasote* and the small adherent quantity (less than one minim) mixed with the two drachms of water. When the fish is immersed therein the first symptoms are those of irritation, the animal darting about and wriggling spasmodically; violent tremors and jerking also occur. In three or four minutes the heart's action had been reduced from 90 to 50 per minute, but was regular, the ventricle slowly contracting after distension. The cardiac action gradually failed; and voluntary motion became indistinct. After the auricle contracts and is dilating, blood flows into it by the auriculo-ventricular opening before the ven-

* Compare with effects on man, 'Poisons,' by Prof. Christison, p. 633.

tricle contracts, and the shrinking of the latter swells the cavity suddenly and distinctly. Regurgitation is thus apparent. The body becomes more or less rigid in about one hour, and death ensues in about two hours, from gradual retardation of the cardiac action, the auricle continuing to act longer than the ventricle.

Sulphuric ether had a simple irritant action at first, then depressed the circulation, there being a diminution of the quantity of blood in the heart in a quarter of an hour, so that both cavities presented a pale muscular ring. Before death ensues the animal is easily recovered by the proper measures.

Chloroform exerted a peculiar influence on the action of the heart after the preliminary excitement had passed away. The cavities contracted slowly and regularly in a quarter of an hour, sometimes ceasing to beat for a few seconds, and again commencing, while there was a stasis in the vessels of the tail and vein (*k*) beneath the intestine. In the former the current in the vessels was gradually slowed, and the jerking of the arteries became more marked. A retrograde motion of the blood was apparent in both sets of vessels, in the arteries backwards towards the heart, and in the veins away from the heart, the current in each by-and-by proceeding and again jerking backwards. The smaller vessels suffered first. The auricle performed its duty most vigorously, for the ventricle remained congested after every pulsation. The animal, however, wriggles convulsively, even after the heart's action has altogether ceased for a minute. Thus, the continuance of muscular vigour would have been no criterion of the dangerous condition of the fish, since active wriggling took place a considerable time after the heart had ceased to pulsate. I did not see the heart's action become irregular at any period; it appeared solely to fail in contracting at all, its beats becoming few, and then ceasing altogether. There were none of the tremulous contractions sometimes met with, and where portions of the fibres seem to show greater inability than others.

Solution of the muriate of morphia was somewhat slow in its action on the fish, requiring a large dose (about fifty minims in two drachms of water) to produce complete loss of voluntary motion in an hour. A more lengthened immersion was necessary to produce the same effect on an embryo *in ovo*. Both recover completely if placed under running water before the circulation has altogether ceased. This was but a mild poison when contrasted with others.

A few minims of a clear solution of *bleaching powder*, added to three ounces of water, proved rapidly fatal to the young

fish. They immediately evinced symptoms of extreme distress, with a tendency to turn on the side. The motion of the pectoral fins was sometimes arrested, and the organs pressed close to the body. The respiratory movements of the lower jaw became slower and slower; starting and gasping occurred, and the operculum was stretched outwards to the utmost. Though placed under running water while still able to jerk, they did not recover.

Chloric ether (one drachm to one ounce of water) caused congestion of the cardiac cavities and great diminution in the frequency of pulsation, viz., from 90 to 30 per minute in a quarter of an hour. In forty minutes the contractions almost ceased, and both cavities were gorged. After immersion in running water the heart began to act more rapidly, but recovery was gradual, the pulsations only amounting to 32 in three quarters of an hour.

Death ensued very speedily when a little *ammonia* (liquor) was added to the water, after spasmodic and violent motions. Though plunged in cold water within a minute, recovery did not ensue. The mouth remained widely distended after death, and the branchiæ gorged with dark blood.

Ten minims of *foreshat*, added to half an ounce of water, produced at first an instant action, with increase of cardiac movements, but the animal soon lay still. The heart's action gradually slowed, the large trunk sending off the blood into the capillary branches (*f''*) with less and less force, so that the latter almost disappeared from sight. Sometimes only a single disc at a time passed along the vessel, whereas many passed formerly. Retrogade and oscillatory movements appeared in the vessels, and the cardiac congestion increased. Both cavities remained distended after death, which occurred in a quarter of an hour or less.

When young fish about twelve days old are placed in pure *sea water* they display little irritability, swimming round the vessel perhaps once or twice, and then quietly resting on the bottom. For the first five or six hours little change is observed beyond a tendency to repose speedily after exertion. Towards the seventh hour there is a considerable diminution in activity, yet the animal readily responds to irritation. The heart's action, which in the fresh water had been 92, has now sunk to 60; both cavities are well filled, and, though rather feeble, the contractions are rhythmical. The pulsations steadily decrease; and in ten or twelve hours the animal lies motionless. It is likewise apparent that the cutaneous textures are shrivelled and rendered more or less opaque. The mouth gapes, and the pectoral fins stand stiffly

out at right angles to the body. Both cavities of the heart are gorged with blood, and though in some there are feeble contractions (from 15 to 20 per minute), the dark central mass is never dispelled from either chamber. This congestion is doubtless augmented by the shrivelling of the superficial textures of the body. In other cases the action of the heart becomes intermittent before ceasing, remaining inactive for a time, with the auricle dark and distended to the utmost, the ventricle also dark, but less bulky, but by-and-by it begins to contract, and pulsates, perhaps, for forty times, and again suddenly ceases, while the feeble circulation —for the moment set agoing—is arrested. No other action of a vital nature could be elicited. The most remarkable change, however, is that which ensues in the yolk-sac before death. This consists of an alteration in its form (from a short to a more elongated condition), and what may be termed a coagulation of its contents, which become at first doughy, so that after being dimpled by a glass rod the outline is recovered very slowly, and finally resiling from the touch of the rod like a rounded and smooth bit of cartilage. Some, indeed, resemble a mass of amber, having a clear yellow aspect, and, when punctured, are not much softer than a fresh lens. Death in this case would seem to arise from cardiac congestion, aggravated by the shrivelling of the cutaneous textures and consequent shutting up of the blood-channels; and, secondly, from interference with nutrition, arising from the change in the condition of the yolk-sac.*

Several young salmon were allowed to touch the tentacles of an Actinia (*Tealia crassicornis*), and then removed; in all the instances death seemed to result slowly from the physical injuries inflicted by the dart-cells on the brain and other organs. The influence of a subtle poison or paralysing agent, at any rate, was not apparent.

Operations.—When the tail of a young salmon, from eight to twelve days old, was cut off at any point behind the bend of the corda (*e. g.* through the dotted line A B), the following effects ensued:—The animal did not wriggle much, and soon rested; an immediate effusion of blood occurred from the ends of the divided vessels, and by-and-by, in some, four or five rounded knobs of blood, or clots, projected from the ends of the vessels, or else a general mass of clot along the cut

* In a sketch of the natural history of the *Salmo salar*, by Daniel Ellis, drawn up from evidence contained in two reports of a Select Committee of the House of Commons, &c. (Jameson's 'Edin. Philos. Jour., vol. iv), it is mentioned that when ova were put in salt water none came to life, and that when a young hatched fish was similarly dealt with it died in a few hours.

surface. No vein as yet carried back blood. Then a vein, running parallel with the bent corda (origin of the cardinal) was observed to commence its current, and soon carried it on most vigorously. This was due to the fact that the main arterial trunk tunnelled a channel in the clot, and poured its contents into the vein. Very rapidly, however, the vein ceased to carry back so much, and finally stopped altogether; and the arteries, which for some time had been diminishing, grew indistinct, sending only a few corpuscles in single file. The clot soon became blanched (from solution and dispersion of its hæmatoglobulin), and the cut border had its margin roughened in a few hours. In eight or nine hours the tip of the corda is protected by a continuation of the cellular border, and there is a considerable increase on the margin of the wound below this. Where the incision is close to the bend of the corda (between A B and B C) bleeding takes place to a greater extent, but the artery slightly contracts, and a clot forms. The animal respires slowly, gasps, and the heart is pale and slow in action. In this condition it is then seen that the aorta also grooves a channel in the clot and pours its contents at once into the vein. When the incision was on the proximal side of the bend of the corda (through B C) this peculiar channelling of the clot did not occur, but the current of the artery passed into the vein after a time by a communicating branch—before reaching the border of the wound. The animal will live for three or four days after the body is severed through the fatty fin, showing the comparatively unimportant part played by the posterior part of its body at this stage, whereas a wound of the yolk-sac is generally fatal.

Regeneration takes place very rapidly in wounds inflicted on the young fish from six to ten days old. For instance, when pieces (D) are removed from the fatty fin, the edges in twelve hours are found papillose from cellular processes, and the angles rounded, while the wound, which formerly was spade-shaped, has now the form of a *V*, the new texture being readily detected by its paler hue. The same ensues in injuries of the tail. When the wound has been deep and somewhat narrow an arch of new texture closes in the cavity before cicatrization takes place at the sides. Considerable portions cut from the pectoral fins are also reproduced.

TRANSLATION.

On the Sexual Reproduction *of the* Infusoria. By Dr. Ernst Eberhard.

(From 'Zeitsch. f. wissenschaft. Zoologie,' vol. xviii, p. 120.)

After a delay which must have appeared of long duration to all who are interested in the study of the Infusoria, the second volume of F. Stein's excellent work* has made its welcome appearance. The volume contains a general review of the present state of our knowledge respecting the Infusoria; and especially discusses the difficult problems that have arisen concerning their sexual reproduction, connected with which is the question of the value of the systematic arrangement of the Infusoria, as proposed by Stein himself, to be based upon the mode of disposition of the *cilia*. This part is followed by a detailed exposition of the systematic arrangement of the heterotrichous Infusoria, in which will be found a full account of *Bursaria truncatella*, one of the giants of a pigmy world, and whose structure and organization is, for the first time, fully expounded.

Dr. Eberhard, who has had abundant materials at his command, has, in almost every essential point, arrived at the same results as those of Stein; and he proposes, in a subsequent memoir, to explain where they appear to differ. On the present occasion he confines himself solely to the point of sexual reproduction, since his results in this subject, though in some respects agreeing with those of Stein, yet in others present a very marked contrast with them.

Stein remarks that he has not unfrequently met with individuals of *Bursaria truncatella* which were filled with a great number of indubitable embryos. The individuals in question, he says, are distinguished from the rest by their spherical form, and the almost complete closure of the peris-

* 'Der Organismus der Infusionsthiere.'

tomatous opening. The embryos were dispersed pretty uniformly throughout the entire parenchyma, and most of them closely embraced by the parenchyma, and were quiescent, whilst others had hollowed out, as it were, the surrounding substance, and moved about actively, and around their own axes, in the watery fluid. The parent animal always had a strap-shaped *nucleus*, but which was not always as large as in the ordinary individuals. The embryos were oval or obovate, and uniformly rounded, and beset with short, delicate *cilia*. At the anterior extremity they appeared to Stein to be furnished with a small tubular process, which he looked upon as a cæcal suctorial disc. At the posterior end was situated a minute, round, contractile vesicle, and in the middle of the body a spherical or elongated *nucleus*. The embryos certainly had no tentaculiform processes, such as are commonly observed in the embryos of other Infusoria. No conjugation of the mature animals was ever witnessed.

The above is a summary of Stein's observations, and the author proceeds to describe his own. In a series of glasses containing *Lemna minor*, for the most part in a state of decay, he was furnished with an abundant supply of *Bursaria truncatella*. At the end of a few days, to his great astonishment, he noticed that all the animalcules were filled, and some of them even crammed with globular bodies of uniform size. Some among them, in which the peristome was almost entirely closed, resembled mere *sacculi* filled with globules, so that it seemed as if the animalcules had surfeited themselves with some kind of pollen, but that the process was in reality one of reproduction was evident enough. He soon remarked that some of the globules were protruded from the still open slit in the parent body, but remained adherent to its outer surface. After the disintegration of the parent—which occurs so readily in this Infusorium—had taken place, and the globular bodies had become liberated, the latter, which were furnished with a contractile vesicle and spherical *nucleus*, presented an *Acineta*-like form, whilst short tentacles, with transparent nodular extremities, sprung up irregularly, in greater or less number, all over the surface. These tentacular processes, in several of the quiescent globules, were seen to increase in size, and occasionally to attain such a length that it would be difficult to distinguish them from the sessile form of *Podophrya fixa*. Some of the more mature globules, soon after their liberation, and often in the course of a few minutes, became elongated, and assumed the form of a somewhat flattened grain of wheat, including even

the median furrow. Towards the anterior pointed end, on one side, was situated the contractile vesicle, and behind this the rounded *nucleus*. The hinder end was more obtuse. The surface of the body, as has been said, was furnished all over with the knobbed tentacular processes, which, however, were more closely set towards either end. In a short time the entire surface became covered with cilia, from amongst which the tentacles projected. The creature now began to exhibit a slow and clumsy kind of movement, which became more and more brisk in proportion to the progressive development of the *cilia*. The mouth might be perceived in the anterior part of the longitudinal furrow. This end is termed the anterior, because it was in the direction towards which the movement tended.

Here, the author remarks, we have an *Acinetaform, which at the same time belongs to the group of the Ciliata*. The tentacular processes gradually disappeared, and the transformation of the animalcule was completed into a ciliated Infusorium, with whose aspect the author had often been familiar, and which he had hitherto regarded as an independent species.

The case above described, so far as he is aware, *is the first recorded instance, in the young of Infusoria, of a transition from the Acineta- into the ciliate-form.*

The observation, moreover, confirms Stein's notion that the minute *Acinetæ* proceeding from *Paramœcium* are in reality its offspring, and not parasites, as asserted by Balbiani. It is no longer doubtful that these forms also eventually assume the ciliate-aspect, which approximates them to that of the parent.

The author has satisfied himself that the embryos of *Bursaria truncatella* above described originate from the nucleus of the parent body. Those individuals which were entirely crammed with embryonal globules had either no nucleus whatever remaining, or merely portions of it, in a decided state of disintegration.

In conclusion, it should be remarked that the diameter of the globular bodies was about twice the usual diameter of the strap-shaped *nucleus*, and that the length of the ciliated form into which they passed was about two thirds of that diameter.

It would seem, therefore, that the points with respect to which the author is at issue with Stein are—

1. That whilst the latter observer insists upon the presence of a nucleus in all the individuals filled with embryos, the author denies its existence.

2. Stein positively denies the occurrence of the Acineta-

form of progeny, whilst the author, relying upon numerous observations, asserts it with equal positiveness.

3. The contractile vesicle which, according to Stein, is situated in the hinder part of the embryo, is placed by the author in the anterior; and the latter was also unable to perceive any trace of a suctorial *acetabulum*.

Such decided contradictions are probably to be explained by some diversity in the modes of propagation, which still demand closer investigation.

REVIEW.

The Journal of the Quekett Microscopical Club. London: Robert Hardwicke.

When the Quekett Club was originally projected we hailed it as an association of amateur microscopists that would diffuse widely a taste for scientific investigation, and contribute to the great object we had in view in establishing the 'Quarterly Journal of Microscopical Science.' It is true that some of the members of the old Microscopical Society looked with a little jealousy at the young club, much as the old Fellows of the Linnean Society in their day regarded the Zoological Club, which terminated in the foundation of the Zoological Society; but in a vast population like London there is, undoubtedly, room for a number of new societies devoted to scientific pursuits. The result has shown that not only has the Quekett Club succeeded, but, so far from doing any injury to the old Society, it has gone on increasing in numbers and influence ever since the establishment of its supposed rival. The truth is, the Quekett Club has been a great feeder of the old Society, and the Members (the Fellows —we beg their pardon) recognised this fact when, at their last meeting, they received with cheers the announcement that the President of the Quekett Club was unanimously elected a Fellow of the Royal Microscopical Society. The President also, with that graciousness which has all along characterised his four years of laborious and useful office, pronounced from the chair his belief that the mother and daughter, after all, had but one common object in their constitution and proceedings. Let us, then, hang down our heads and blush when we think of the hard words and ungenerous feelings which have been exhibited between the two societies.

We do not feel called upon to give any opinion about the propriety of the Quekett Club starting a journal of their own. Did we stand upon our dignity, we think they ought to have consulted ourselves, and asked us whether we thought

their journal would interfere with our interests. But as they have not thought fit to do so, we heartily forgive them, and here hold out the right hand of fellowship to them as fellow-journalists. Of course, we hold our right to fall foul of them, to criticise them severely, and to encourage them benignly, as all elder journalists think they have a right to do with the younger and aspiring fry.

Our young competitor is small, as most babies are, but still it gives promise of a vigorous growth. The original papers are interesting, and we should have been glad to have published them in our own Journal had they been sent us. We think they would have been no disgrace to the 'Transactions' of our own Royal Society. One of the features of the journal is a "Microscopical Bibliography," which, if it is continued as well as it has been begun, will be a real acquisition to microscopic observers. Our young friend has not, in the present number, ventured on plates; and as these are expensive things, as we know to our cost, it will probably, with the wisdom which has characterised all the proceedings of the Club, consider well this question in the future.

In conclusion, we heartily wish the Quekett Microscopical Club and its Journal success, feeling assured that no earnest effort in scientific research is ever lost. The jealousies and rivalries, yea, even the noble ambition of seekers for the truth, will all one day be thrown into oblivion, but the smallest contribution to the accumulated stores of human knowledge will remain for ever, the imperishable record of the existence of the man who made it.

QUARTERLY CHRONICLE OF MICROSCOPICAL SCIENCE.

Bibliotheque Universelle.—"*Reisen im Archipel der Philippinen,*" by C. Semper.—Prof. Claparède gives a most interesting notice of this recently published and highly important work. M. Semper has resided for seven years in the Philippines and Carolines, and now intends publishing the scientific results at which he has arrived, and the history also of his travels. This publication will comprise naturally two parts, and it is to the second, the more especially scientific, that the author has first put his hand. The three first *livraisons* of the first volume are devoted to the study of the Holothuriæ. They are accompanied by twenty-five plates, printed in colour, which do the greatest honour to the chromolithographic studios of M. Hener at Hamburg, and of M. Bach at Leipzig, as well as to the celebrated publisher and true protector of natural sciences, Herr Wilhelm Engelmann. This first volume may with propriety be termed a monograph of the Holothurians, for the author offers us not only a careful zoological and anatomical study of the new species which he has met, but also a critical revision of the forms already known, and some general considerations on the entire class of Holothurids, and on the orders and families which compose it.

Amongst the well-known calcareous corpuscles, of which the position is always in the Holothurians the corium, M. Semper distinguishes two categories: on the one hand the anchors and wheels, generally known from the Synaptids, as also the very characteristic corpuscle of the proper Holothurians, corpuscles which the author distinguishes because of their form by the name "stools" (Stühlchen); on the other hand, the perforated plates, the ramified corpuscles, &c., which always have their position in deeper layers of the corium than the preceding. The author calls these last *connective corpuscles*. It is these which in certain cases give rise, by their union, to large calcareous plates (*Psolus*,

Ocnus, &c.), which recall the cutaneous skeleton of the Echinids. Either the "stools" or the connective corpuscles may sometimes be entirely deficient. However, the case where calcareous corpuscles of all forms are absolutely wanting are very rare (in certain types of the family of the Synaptids and of the Molpadids).

It is well known that all the Holothuriæ are characterised by the presence of a ring composed of calcareous pieces disposed round the pharynx; a ring which one might, perhaps, consider as the homologue of the lantern of Aristotle in the Echini. This organ is formed, as a rule, by ten pieces, of which five are radial and five interradial, the former each pierced by an opening for the passage of the aquiferous ambulacral vessel. M. Semper cites a case, that of a Pentacta from Japan, in which the interambulacral pieces are entirely absent, and the ambulacral pieces are reduced to little calcareous plates, lodged in the skin of the pharynx. M. Semper distinguishes two forms of ambulacral appendices: the *ambulacral feet*, furnished at the extremity with a sucker strengthened by a calcareous plate; and *ambulacral papillæ*, which are conical and pointed. The first belong, as a rule, to the ventral trivium; the second to the dorsal bivium. However, in certain cases, one can find ambulacral feet on the back, and also ambulacral papillæ on the belly—exceptions which are both realised together in the genus Sporadipus. As is known, ambulacral appendices are totally wanting on the back of the Dendrochirotids. Among the Molpalids these appendages are absent throughout, though the branches corresponding to the five ambulacral vessels do not the less pierce the skin. Lastly, in the Synaptids of the tropics, the author establishes the complete absence of the five ambulacral vessels, which M. Baur had already done for the European Synaptæ.

The *organs of Cuvier* sometimes are attached directly to the cloaca, sometimes to the stem of the lungs. The author confirms afresh the view that they are not hollow, but solid, and he contests their glandular nature. He considers them as a sort of weapon that the animal can push out behind by the cloaca. It is true that this phenomenon is always accompanied, like the projection of the viscera so peculiar to the Holothuriæ, by the rupture of the wall of the cloaca.

Among many Holothuriæ (Aspidochirotids) the dorsal vessel is broken up in the intestinal loop into a rete mirabile, which becomes entangled with the ramifications of the left lung. Johannes Müller admitted that this entanglement does not constitute by any means a close union of the two

organs, but a simple juxtaposition. At the same time, M. Semper has established the existence of fine strands, which pass from the rete mirabile to the follicles of the pulmonary tree, and lose themselves in the connective tissue of this organ. It is true that, to judge from the expressions of the author, these "cordons" do not appear to enclose vessels, and that the respiratory function of the so-called lungs remains as ever somewhat problematical.

The new Holothuriæ collected by M. Semper have been figured with very great artistic skill, some by the author himself, others by Madame Anna Semper. Many among them are remarkable not only for their form, but also for their size, since we find among them Synaptæ of five or even of seven feet in length, to which the natives of Celebes have with reason given the name of sea-serpents. Among the anatomical and zoological details which accompany the description of each of them, we find many new and interesting facts.

The anchors of the Synaptæ are by no means, as is often believed, locomotive organs; when they have laid hold of any part, the animal cannot disengage itself without sacrificing them. They are, it is true, movable on their basilar plate, but there are not any muscles destined to move them, and the will of the animal has no action on their movements. Besides, the body of the Synaptæ does not cling to the hand except when one touches it roughly. In reality the Synaptæ crawl on stones and plants without hooking on to them, and in *Synapta Beselii*, the anchors are lodged so deeply in the skin that M. Semper believed in their complete absence until microscopic examination showed him the contrary. M. Semper has increased the number of known Synaptæ in a considerable manner. The Archipelago of the Philippines ranks to-day as one of the best known tropical regions, thanks above all to the researches of Mr. Cuming, that "prince of collectors," as he has been called; and although before M. Semper's work only a single Synapta was known from that archipelago, the number is now, owing to his researches, increased to eleven, without counting a Chirodota. It is true that Mr. Cuming appears to have collected among Invertebrates only those animals with a hard shell, since he has completely neglected the Cephalopods, which so abound in tropical seas. In 1859 the total number of known Synaptids was thirty-three species. This number ought to be increased now-a-days by fifty-seven per cent.; for if we consider the fact that the majority of the new species come from the Philippines, and thence too from a single locality (the

little isle of Bohol), it is probable that researches made in other seas of the tropics will increase this number largely.

Relatively to the ciliated funnels (Entonnoirs of d'Udekem) of the Synaptids the author affirms, as Müller and M. Baur also do, that they cannot be considered as the internal terminations of the aquiferous system any more than of blood-vestels. It is, then, impossible to assimilate the blood-vessels of the Holothurids to the vascular excretory apparatus of worms, and the ciliated funnels of the Synaptids cannot be compared to those of Annelids. They are, without doubt, an apparatus destined to excite a current in the liquid of the cavity of the body.

The family of the Molpadids embraces a series of forms, united, it is true, by common characters, but connected, nevertheless, by certain points, to the most diverse genera of other families of Holothurians. One might consider them in a certain way as a collection of prototypical forms. The complete absence of feet approximate them in appearance to the Synaptids; but the genus Echinosoma is the only one which justifies entirely this approximation by the complete absence of the radial canals of the skin. In the other genera studied by M. Semper, the aquiferous canals traverse the skin fully from part to part; but instead of being prolonged into feet, as in the Holothuriæ, they terminate in cæca, under the epidermis. One part, at least, of this family appears to comprise hermaphrodites species. If the family of the Molpadids comprises forms to a great extent heterogeneous, that of the Dendrochirotids is, on the contrary, very uniform. M. Semper is led to reduce notably the number of the genera which has been increased in a large proportion by M. Selenka. From what we knew till now as to this family, we had the right to consider it, in opposition to that of the Aspidochirotids, as belonging essentially to the boreal and to the temperate region. This opinion would, however, have been entirely false. Before the recent work of M. Selenka, the relation of the known species in the tropical region to that of the species of the temperate and boreal zones was as one to twelve; after the work of this *savant*, the ratio was as one to five; and now, after the study of the species of the Philippines, it is become as one to one and a half. It is, therefore, probable that researches made in other tropical regions will continue to modify the ratio in the same way. When one runs through the list of the Holothuriæ of the Museum of Cambridge (Massachusets), published by M. Selenka, that of the Museum of Berlin, and that of the Godefroy Museum at Hamburg, one might be disposed to

consider that the tropics are very poor in Dendrochirotids; but this would be an error. These Echinoderms have not yet been collected by searching out their mode of life. In fact, whilst the majority of the Aspidochirotids live in the shallows within the reach of travelling naturalists, the Dendrochirotids of the tropics live all at a great depth, whence the dredge only can gather them. A thing well worth remark is, that these Holothuriæ, living at great depths in the Philippine Archipelago, are precisely of the forms which (as the Psoli, Cucumariæ, and Echinocucumes) approach most nearly species of the boreal zone. It may be mentioned in passing, that it is in these conditions that M. Semper has fished up at the Philippines a Stellerid of the genus Pteraster, which he can scarcely distinguish from *P. militaris* of the coasts of Scandinavia.

The Aspidochirotids, or Holothurians properly so-called, as well as being very numerous in species, constitute, like the Synaptids and the Dendrochirotids, an extremely uniform family. It has often been repeated that the inspection of a single calcareous corpuscle of the skin of a Holothuria is sufficient to permit of the determination with *certainty* of the species to which the animal belongs. M. Semper shows, on the contrary, that the majority of these corpuscles can furnish only very uncertain conclusions, not only as to species, but also as to genus.

M. Semper adds to his 'Monograph of the Holothuriæ' some very curious details as to the parasites of these Echinoderms. With the exception of some little Copepods living as Epizoa on different Holothuriæ, the Dendrochirotids appear to be entirely free from parasites. The singular parasites observed by M. Semper live all on the body or in the interior of the Aspidochirotids. Nearly all belong to zoological groups, in which parasitism is a rare exception. For example, in the first place, the fishes,—which belong almost all to the genus Fierasfer, Quoy and Gaimard. These fishes were first described by Risso, and Delle Chiaje has figured the two Mediterranean species very well. Their entrance into the Holothuria, as well as their exit, appears to take place through the lung. M. Semper possesses the pulmonary tree of a Holothuria, in which is lodged one of these fishes, which appears to be in the act of entrance, for its head is turned towards the further ramifications of the organ. They appear to be true parasites, since the author has always found their stomach filled up with the *débris* of the lung of their host. Another genus of parasitic fishes of

the Holothuria is that of Enchelyophis (Joh. Müller), which is entirely destitute of pectoral fins.

As to Crustacea, M. Semper mentions, besides some small Copepods, two species of the genus Pinnotheres, which lives, as is well known, ordinarily as a parasite in Lamellibrancha. It is remarkable that these two species are parasitic in the same Holothuria, where they are constantly found in the right lung, that is to say, in that which has no connection with the enteric vessels. Sometimes the lung which lodges a Pinnotheres is completely atrophied, but in this case another is developed in an abnormal position.

The Molluscs number several parasites of Holothuriæ; and firstly the celebrated *Entoconcha mirabilis,* discovered by Joh. Müller in the *Synapta digitata* of Europe, has its counterpart, not now in a Synapta, but in a Holothurian properly so-called, found in the Philippines. This extraordinary Gasteropod has been christened by M. Semper by the name *Entoconcha Mülleri.* It appears to be restricted, as a rule, to the cloacal region. Mr. Cumming long since pointed out the presence of Eulima in the stomach of the Holothuriæ; but it appears to have been generally considered that these Gasteropods had been swallowed by the Echinoderms. This opinion is erroneous. M. Semper possesses two or three species, which he has found alive and crawling joyously in the intestine of the Holothuriæ. These species are exceedingly active in their movements, in opposition to the epizoic species, the foot of which is in general buried in the skin of their host. The sole food these Gasteropods have at their disposal is the chyme, or indeed, the secretions of the intestinal epithelium. They may, therefore, well be called parasites. It is not improbable that conchologists are wrong when they state that the Eulimæ and the Stylifers (which live among the spines of Cidaris and other Echinids) do not obtain their food from their hosts. They appear to forget that the spines of the Echinoderms are not merely cuticular formations, like the shells of molluscs. Parasitism is clearly evident in a species of Eulima found by M. Semper in a cavity of the skin of a Holothuria, of the genus Stichopsis. During the life of the Echinoderm the shell is nearly entirely hidden in the skin, the summit of the spire alone slightly protruding. If one tries to remove it a strong resistance is felt. But when the Holothuria is moribund, one can succeed in withdrawing the mollusc armed with a long and fine thread, which, in large individuals, at any rate, can penetrate right into the cavity of the body of the Holothuria. This thread is nothing else than the greatly elongated proboscis of the mol-

luse; and the mouth of this animal being thus deeply lodged in the skin of the Echinoderm, it is clear that it can only be nourished by means of the latter. This mouth, being deprived of all trace of armature, is, without doubt, destined to absorb liquid or soft parts. M. Semper appears to be disposed to consider that all the other Eulimæ (equally destitute of jaws) which live on Holothuriæ, or on other Echinoderms, are nourished by the mucus secreted by the epidermis of their host.

Lastly, a very singular parasite is a little Lamellibranch, which lives on the skin of a Synapta, where it is found crawling actively by means of a large and almost membranous foot. This animal belongs to that small group of Lamellibranchs which, like certain Cephalophora, have only an *internal* shell, or at least in which the mantle is reflected so as to envelope the primitive external shell. In the species in question the mantle is, it is true, completely closed, in such a manner that the shell is internal in every sense of the term, whilst in certain Erycinæ the suture of the two halves of the mantle is not complete.

The richness of the materials of which this first volume gives us knowledge makes us impatient, concludes Professor Claparède, to see the appearance of those which are announced to succeed it.

Max Schultze's Archiv. Vol. IV, Part II.

I. "*On the Nerves in the Tail of the Frog Larva*," by Dr. V. Hensen.

II. "*On the Cells of the Spinal Ganglion and of the Sympathetic in the Frog*," by L. G. Courvoisier.

III. "*On the Structure of the Lachrymal Glands*," by Franz Boll.

IV. "*On the Taste-Organs of Mammals and of Man*," by G. Schwalbe.

V. "*On Invaginated Cells*," by Dr. F. Steudener.

VI. "*On the Structure, especially of the Vaterian Bodies, of the Beak of the Snipe*," by Franz Leydig, of Tubingen.

This number of the 'Archiv' is remarkable for its papers on nerve-structure, especially as to nerve-endings. Dr. Hensen has carefully studied that favorite subject for investigation in these matters, the tadpole's tail. He points out and figures very beautifully the termination of nerves in the epithelial cells. As the result of various researches, he is led to conclude that the nerves, with the exception of the sympathetic, are exclusively a tissue belonging to the corneous layer of the embryo; that they, therefore, must end in cells or cell-derivatives of the corneous layer, to which,

according to Hensen's experience, the striped muscles also belong; and that the nerves do not grow out into a tissue, but, through the separation of particular cellsand tissues from one another, become differentiated. He quotes, in addition to his own observations, the ending of nerves in the salivary-gland-cells, in the epithelial cells of the cornea, the rods and cones of the retina, which are simply the epithelium of primary optic vesicle, and therefore continuous with the body-surface originally; also, lastly, the ending of nerves in teeth. Kowalevsky, in his researches on the development of *Amphioxus lanceolatus*, recently pointed out the termination of nerves in the epidermic cells of the skin of this fish.

Courvoisier's paper is principally controversial, and intended to establish his claims in the matter of the spiral and straight fibres of bipolar ganglion-cells. It is illustrated by a plate. The views of Beale, Kölliker, Arnold, Sanders, and Krause, are fully discussed.

Franz Boll's paper is one of great interest, and, like his paper on the structure of the tooth-pulp and its nerves, which we recently noticed, is a most creditable example of the work which Professor Schultze enables his pupils at Bonn to accomplish. The author's observations are similar to those of Pflueger on the salivary glands. He points out the existence of a network of multipolar nerve-cells in the tissue of the gland, and traces the termination of some of the nerve-fibres in the gland-cells. These matters are illustrated in a clear and well-drawn plate.

Dr. Schwalbe's paper is a very extensive treatise on the minute structure of the papillæ of the tongue, the peculiar "schmeckbechers," and their relation to the nerves. He points out the existence of certain very remarkable nervous structures. The paper is illustrated with two plates, and, taken in connection with that of Dr. Christian Loven, published in a previous number of the 'Archiv.,' furnishes a very noteworthy addition to the knowledge of the structure of special-sense-organs.

The invaginated cells observed by Dr. Steudener occur in carcinomatous lymph-glands and in carcinomatous livers. The appearance presented is such that the structure might be taken for mother-cells, with enclosed daughter-cells; but by a series of transitional forms figured in his plate, the author shows that one cell may be gradually squeezed into, or closed in by, another.

In the beak of the snipe (*Scolopax rusticola*) are certain large corpuscles in connection with the fibres of the nerve, and surrounded by a densely vascular tissue. These are

described, drawn, and their meaning discussed by Dr. Leydig.

Societa Italiana di Scienze Naturali. "*Studies on Cochineal Insects*," by A. Targioni Tozzetti.—Professor Tozzetti has been good enough to send us this and the following memoir, which are very exhaustive and valuable treatises. The complete history and anatomy of several *Cocci* is most elaborately worked out by the author, and illustrated by most faithful-looking drawings in seven large quarto plates. So thoroughly complete and careful examination as Professor Tozzetti has given to these insects makes his work a most important pendant to the researches of Huxley, Lubbock, Balbiani, Mecznikow, and Claparède, on allied hemipterous forms.

"*On the Light-organ of Luciola Italica, and on the Muscular Fibre of Arthropods*," by Targioni Tozzetti. This paper contains a full and careful description of the organs in question, illustrated by two plates.

Miscellaneous.—"*A Monograph on the Structure and Development of the Shoulder-Girdle and Breast-Bone in the Vertebrata*," by W. Kitchen Parker, F.R.S. (Ray Society.) —"We cannot," says Mr. Parker, "take a step in this department of anatomical science without a thorough acquaintance, not only with the histology of the skeleton, but also with that of the rest of the tissues that go to make a vertebrate animal." Hence the last volume issued by the Ray Society has considerable interest for microscopical observers. The study of osteology is just now receiving from the hands of such men as Professors Gegenbaur and Huxley and Mr. Parker a turn in quite a new direction, the importance of which cannot be overestimated. Following in the steps of Rathke, the osteologist has now to consider in his determinations of homologous bones, not merely the position or relations of the bone in question to other bones, but, above all, he has to ascertain and make allowance for its origin and mode of development. "Skin-bones," "membrane-bones," and "cartilage-bones," are now carefully discriminated. Mr. Parker, taking counsel, as he says, with Professor Huxley, proposes three terms—*endostosis*, *ectostosis*, and *parostosis*—by which to distinguish the three chief modes of ossification. "Endostosis" is that ossification which commences in the intercellular substance of hyaline cartilage. That bony matter which is first found in the almost structureless inner layer of the perichondrium, in immediate contact with the outermost cartilage-cells, is formed by a process which may be called "ectostosis." Such a bony formation

as appears primarily in the skin, in the subcutaneous fibrous mesh, or in the aponeurotic tracts, may be called "parostosis." Bones which were thought to be homologous prove, when examined by the light of this division of the ossifying process, to be quite distinct, originating in many cases quite differently; and others supposed to be simple prove to contain both ectosteal and parosteal elements. In the Elasmobranch Fishes Mr. Parker has studied (as also has Gegenbaur) the essential cartilaginous part of the shoulder-girdle. In the Ganoid and Teleostean Fishes he is able to point out what membrane and dermal bones (parosteal elements) are added thereto; and thus, starting with a clear knowledge of these two distinct factors, he is able, when he arrives higher up in the scale, amongst reptiles, birds, and mammals, to trace out the gradual fusion of the two elements, and to show, in the simple-looking but often highly complex bones of the shoulder-girdle which part represents this or that membrane- or cartilage-bone in the fish, and what is special and peculiar to the class under consideration. The magnificent volume, with its thirty coloured plates, which Mr. Parker has produced, contains the most accurate details concerning these structures, and is the result of a surprising amount of research and industry. Mr. Parker's method has yet to be applied fully to other parts of the skeleton, and, as he himself suggests, it is to be hoped that the present volume may be looked upon as a specimen of what sound osteological research should be at the present time, and that others may be induced to work in the same way and with as valuable a result.

A new Rotifer.—We recently noticed Professor Mecznikow's discovery of *Apsilus lentiformis*, a Rolatorian entirely destitute of vibratile cilia, and M. Claparède now communicates an account of an animal of the same kind observed by him some years ago in the Seine, a small river of the canton of Geneva. It was found creeping on the bodies of Trichodrili, and other small Oligochœta. The body of this animal, to which M. Claparède gives the name of *Balatro calvus*, is more or less vermiform, and very contractile. Its posterior extremity (foot) is divided into two lobes, of which the ventral is semilunar, with acute angles, which are capable of invagination. The dorsal lobe forms a flattened cylinder terminated by three mammillæ. Between the two lobes the anus is situated. The anterior extremity, which is indistinctly annulated, is capable of retraction as in other Rotatoria. The mastax is not largely developed, and is armed with a very small incus, and with two curved mallei; it

opens directly into a thick-walled intestine, the inner layer of which is brownish. The intestine is more simple than in the Rotatoria generally; it extends in a straight line from the mouth to the anus, and its narrowed anterior part scarcely merits the name of œsophagus. No glands were observed in connection with the stomach. When the animal is extended the curved mallei project externally. All the individuals observed were females. The ovary occupies the ventral portion of the body; beneath the intestine, the mature ovules are ovoid, and occupy the posterior extremity of the body. M. Claparède characterises his genus Balatro as follows:—Body vermiform, very contractile; posterior extremity terminated by two lobes—one ventral, of a semilunar form, transverse; the other dorsal, nearly cylindrical, acting as a foot. Mallei in the form of crooks. No vibratile organs; no eyes. Besides Apsilus and Balatro, Taphrocampa of Gosse is a genus of Rotatoria destitute of vibratile cilia. Mr. Gosse placed it originally near Notommata and Furcularia, but has since removed it to the neighbourhood of Chœtonotus, among the Gastrotricha. In this M. Claparède thinks he is wrong, as Taphrocampa possesses a mastax, the structure of which is very near to that of the Furculariæ and Monocercæ. M. Dujardin also describes his genus Lindia as destitute of cilia; and M. Claparède regards it as nearly allied to his Balatro, which is still more closely related to Albertia.

"*On the Mode in which certain Rotatoria introduce Food into their Mouths,*" by E. Claparède.—In the Zygotricha of Ehrenberg the vibratile apparatus may be regarded as double. The movement of the cilia is always in the same direction, namely, opposite to that of the hands of a watch; hence it is directed towards the mouth in the right wheel, and from it in the left one. But observation proves that food passes to the mouth both from right and left, which is incompatible with the received notion that the currents conveying the food are produced by the vibratile apparatus. The examination of such Rotatoria as the Melicertæ and Lacinulariæ leads to the same result. In *Melicerta ringens,* on the lower surface of the membranous vibratile organ and parallel to its margin, M. Claparède finds a sort of crest, between which and the margin there is a deep furrow. The extreme margin bears the well-known large cilia; the crest also bears cilia, but these are long and delicate, and their movement is opposite in the two halves of the apparatus. By their means foreign bodies which get into the channel between the two ciliated crests are pushed gently along and conveyed to the mouth, being retained in their position by the inferior range of cilia.

The action of the whole apparatus is explained as follows by Professor Claparède:—The superior range of cilia, when in action, produces currents tangential to the vibratile organ and perpendicular to its plane. These currents are closed, and appear to be nearly of an elliptical form; particles involved in them pass repeatedly over the same course, and if they are thus brought in contact with the extremities of the inferior cilia, which reach a little above the base of the superior range, they pass into the channel above mentioned, and are pushed along in it towards the mouth. The author remarks that the *apparent* movement of the inferior cilia is from the mouth; but this is illusory, and due to the circumstance that the slow elevation of each cilium preparatory to its stroke produces a greater effect upon the eye than the more rapid stroke itself. This double row of cilia in Melicerta and Lacinularia has been observed and described in this country by Huxley and Williamson, and in Germany by Leydig, but its existence seems to have escaped the notice of subsequent observers. Professor Huxley has also observed this second row of cilia in Philodina, a genus belonging to the Rotatoria Zygotrocha. M. Claparède here describes and figures it in *Rotifer inflatus* (Duj.), in which the inferior cilia are borne upon a crest which is oblique relatively to the plane of the vibratile wheel; in all other respects the arrangement and action of these inferior cilia are the same as in Melicerta. The same characters have been observed in *Rotifer vulgaris* (Ehr.). M. Claparède appends to this paper a note confirming Mr. Gosse's account of the mode in which *Melicerta ringens* builds up its tube, and remarks that this does not appear to have attracted attention on the Continent.

"*Teeth of Fossil Fishes from the Coal-measures, Northumberland.*"—Professor Owen has published a paper, illustrated by very beautiful figures in fifteen plates, in the 'Proceedings of the Odontological Society.' He describes various new genera and species on these characters. Mr. Albany Hancock and Mr. Thomas Atthey, however, publish papers in the 'Annals and Magazine of Natural History,' in which they point out what they consider to be serious errors in Professor Owen's paper, and refuse to admit some of his genera, they being founded on fragments only of the teeth of other genera.

"*Dentition of the Mole.*"—Mr. C. Spence Bate has also sent us a copy of his paper on this subject, published by the Odontological Society. Mr. Bate's researches on the development of the teeth are highly interesting, and clearly prove

that the tooth called canine in the upper jaw is no canine at all. Unaccountably, Mr. Bate comes to the conclusion that Professor Owen's formula is the right one—a conclusion from which, on a former occasion, we dissented.

"*Researches on the Compound Eyes of Crustacea and Insecta.*" (Untersuchungen über die zusammengesetzten Augen der Krebse und Insecten.) By Max Schultze.

"The percipient elements of the retina," as the author observes, "both in Invertebrate and Vertebrate animals possess a definite structure adapted to the function they have to perform, and as this, in both cases, is the perception of one and the same motion in the waves of the ether upon which all luminous impressions depend, it is, *primâ facie*, probable that the structure in question would be essentially alike. Another question, however, arises—whether we are at the present time or ever shall be able to discover by means of the microscope the actual physical conditions upon which it must be presumed the percipient power of the termination of the optic nerve depends. For although we know the length of the undulations, and are able easily to measure them, the difficulty still remains of reconciling the enormous rapidity of their recurrence with what we know respecting the rate of perceptivity through the nerves themselves; a difficulty which would seem calculated much to lessen the hope of our being able to discover any relation between the visible structure and the undulations of light."

The discovery, however, by the author, of the universal existence of a very regular, laminated structure in the outer segments of the "rods" and "cones" of the retina in man and other Vertebrata,* affords an inkling of the direction in which we may look for some definite view with respect to a purely mechanical theory of light- and colour-perception. If Zenker† is right in considering that in the case of the reflection of light in the laminated structure of the rods, which may be compared to a set of glass-plates, a system of *statical* waves must be established (which can only take place, for the different coloured rays, where the reflecting surfaces are at the proper distances apart), we may arrive at some idea as to how the varying length of the undulations of the different coloured rays is perceived irrespective of their enormous rapidity.

In this view the laminated structure of the percipient rods would seem to be of fundamental importance, and the author

* 'Archiv. f. microscop. Anat.,' III, 1867, p. 215.

† 'Versuch einer Theorie der Farbenperception.'

has consequently been led to inquire whether it exists as well in the invertebrate as in vertebrate animals. The result of his observations is fully confirmatory of what had been already stated by Leydig in 1857, viz., that the bacillar stratum of the retina in the Arthropoda corresponds in all respects, physically and chemically, with that of the same elements in the vertebrate retina, and that the rods exhibit a fine transverse striation, which is readily perceptible, especially on the addition of water, even in the large "rods" of the naked Amphibians.

But a still more important question was to be decided—as to what parts in the eyes of Crustacea and Insects were destined for the collection of the visual rays, and by which of them the percipient function was performed.

Each segment of the compound eye, as is well known, represents a sort of tube closed at the outer end by a convex transparent cornea, and containing a conical crystalline body, supported on the outer end of the "rod," whose inner end is in connection with the optic ganglion, upon which the whole organ is, as it were, supported.

Since Müller's researches in 1829, it has been generally conceived that the cornea and crystalline cone together formed the refractive apparatus, and that the image was perceived at the extremity of the nerve, where the point of the crystalline cone comes in relation with it. The question then arises as to whether each separate segment or tube of the eye receives and perceives a distinct image, or whether all of them together concur in the formation of a general image, and the conveying of its impression to the percipient centre. Müller appears to have been inclined to adopt the latter view, but it has been since shown by several observers, and especially by Gottsche* and Zenker,† that minute inverted images are formed in each facet; so that, as stated by Zenker and R. Wagner, "the compound eye can only be regarded as an aggregation of so many simple eyes."

But this view demands the solution of the question as to the point and mode of termination of the nerve fibres behind the "crystalline cone," and also as to the number of the percipient terminal points at that situation, since it is clear that a single nerve-termination cannot perceive an entire *image*. Leydig, whose opinion on any question of the kind is of the greatest weight, says that the "nerve-

* Müller, 'Archiv,' 1852, p. 483.

† 'Anatomisch-systemat. Studien über die Krebsthiere,' 1854, p. 30.

fibre," or "rod," and the "crystalline cone" are continuous in substance, and constitute merely divisions of one and the same structure; thus, in fact, regarding the entire apparatus as resembling the "rods and "cones" of the vertebrate eye. As this view is opposed to that of many other writers, amongst whom M. Claparède may be cited in the first place, it became an object to determine the exact relation between the "crystalline cone" and the "rod." According to Max Schultze, its point is merely in apposition, and has no organic connection with the outer end of the "rod." The next point he takes up is the intimate structure of the "rod" itself, which he shows to possess the same laminated structure that he had discovered in the outer segment of the "rods" and cones in the human and other vertebrate retinas.

The memoir also includes an interesting account of the differences existing between the eyes of nocturnal and diurnal insects. In the nocturnal moths, for instance, the cornea is usually quite colourless, and thus is capable of transmitting all the luminous rays, whilst in the diurnal Lepidoptera the corneal facets have in most cases a yellow border, sometimes very intense, so that in these cases the rays towards the violet end of the spectrum must be in great measure absorbed. It is to be observed also that in the diurnal Lepidoptera the "crystalline cone" has itself a yellowish tint, and is imbedded in a coloured pigment, whilst in the nocturnal it is colourless and at the same time larger, so as to be capable of collecting a greater number of rays. It is curious to observe the close analogy thus shown to exist between the "rods" and "cones" of the retina in night- and day-flying birds, as referred to in the notice of a former paper by Max Schultze, given in the Journal (Vol. XV, p. 25).

Other interesting peculiarities respecting the differences between nocturnal and diurnal Lepidoptera will be found in the memoir.

"*Deuxième Série d'Observations Microscopiques sur la Chevelure.*" Paris, 1868. (Extrait du Tome iii, des 'Mémoires de la Soc. Anthrop. de Paris.')

A 'Second Series of Microscopic Observations on the Human Hair,' by M. Pruner-Bey, has lately appeared, with five plates of figures, showing the forms of transverse sections of the hair in various races of mankind, and in many cases at different ages. Several of the more interesting races are represented by a considerable number of individuals, so that the characters of their hair have been established with great

precision. Other isolated specimens belong to less known races, but M. Pruner-Bey has thought it advisable to include them for future comparison. He says a few words with reference to the observations contained in his former memoir on the same subject respecting the characters of the hair, which are visible to the naked eye.

1. With respect to colour, he has established the fact that it is not always *black* in the negress. Besides a red colour, which is very exceptional, he has met with hair of an ashy (*cendrée*) tint in some cases, in which the other characters were perfectly nigritic. 2. Among two hundred specimens of hair from natives of India, only one occurred of a straw-colour, and even this might have been of foreign origin. The hair of every race south of the Himalayahs is jet black; but in proportion as we ascend into the more elevated regions a brown colour occurs more and more frequently.

In general, M. Pruner-Bey's recent observations have confirmed what he has before announced, viz., that the colour may differ in different branches of one and the same race, independently of any other change in the characters of the hair. But the same observation does not hold good between different races, especially when the pigmentation is examined microscopically in transverse sections.

As was shown in his former communication, the differential characters of the hair of various races are found chiefly in the forms presented by transverse sections. Such sections, moreover, afford an opportunity of determining not only the *form*, but also the *size* of the hair, a character which M. Pruner-Bey considers of the greatest importance.

Amongst the principal races whose hair forms the subject of the present communication may be enumerated amongst the Semitic—Arabs and Jews; and as types of the Arian family, Grecks, Brahmins, Lithuanians, &c. It would appear that, according to M. Pruner-Bey, there is a marked difference between the Semitic and the Arian races. The latter showing a regular oval outline in the transverse section, and the former one of a more or less angular outline; so that, as the learned ethnologist remarks, we might almost fancy that the angular traits of the Hebrew visage were repeated in the transverse section of the hair!

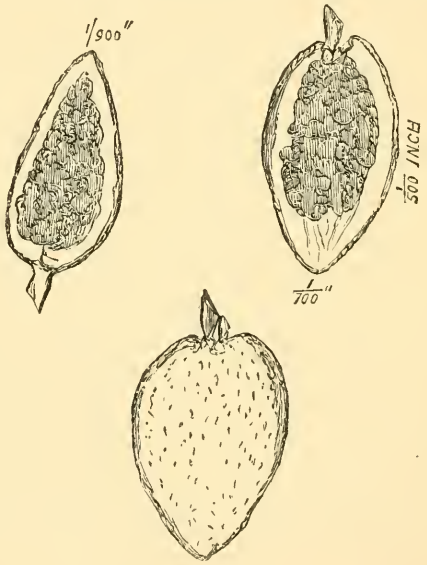
Amongst the so-termed Turanian races, we find Fins, Esthonians, Samoyedes, natives of Sicily and Kabyles, &c. Other races are Korouglous, Nigritoes, Australians, Malays and Polynesians—Americans, Chinese, Annamites, Japanese, Santals, and finally an ape; the hair of the latter having been

diagnosed by M. Pruner from its microscopic characters alone. It resembled in some respects the hair of the human infant, but differed from it in the perfectly uniform dissemination of the black pigmentary matter and the consequent entire absence of any trace of structure.

NOTES AND CORRESPONDENCE.

Colour of the Sea.—As a pendant to the admirable paper by Dr. Collingwood, published in the April 'Quarterly Microscopical Journal,' permit me to send you the following notes.

During the voyage of this vessel from Valparaiso hither, at the end of last and beginning of this month, the sea was



noticed to be sensibly discoloured for about 500 miles. Some sixty miles south of Callao (lat. 13° south) the colour was brownish-green; close to and at about ten miles from Callao the sea was covered by many patches of thick reddish-brown scum. This occurred at intervals; but more to the north, off the Lobos Islands, the scum had disappeared, and there

were only scattered *clouds* of bloody water. This was at some fifty miles from the shore.

It was several times examined, either as scum or the strainings of the discoloured water, and always with the same results. I enclose a specimen, and also a very rough sketch, taken near Callao.

It may not be irrelevant for me to say that I have many times seen and examined *red* water, more especially while off the West Mexican and Californian coast. The colour was not always due to Trichodesmium, but I do not remember any instance of animal life being the cause. The Gulf of California is so notorious for its occasional tinging as to have been called by the old Spaniards *colorado*, *red* or *ruddy*.—J. Linton Palmer, F.R.C.S.E., Surgeon H.M.S. Topaze, at Panama.

PROCEEDINGS OF SOCIETIES.

Royal Microscopical Society.

April 8th, 1868.

James Glaisher, Esq., F.R.S., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

Dr. Jayaker was duly elected a Fellow of the Society.

The following presents were announced, and thanks voted to the respective donors:

	Presented by
Seven Slides of Crystals.	Mr. J. Norman.
Six ditto from Tasmania	Mr. E. D. Harrop.
Journal of Linnean Society	Society.
Land and Water (weekly)	Editor.
Journal of Society of Arts (weekly)	Society.
Journal of Photographic Society	Editor.
Journal of Quekett Club	Club.
The Student	Publisher.
Popular Science Review	Ditto.
British Journal of Dental Science	Editor.
Dental Characters of Genera and Species, chiefly of Fishes, from Shales of Coal, Northumberland. By Professor Owen, F.R.S., &c.	Author.
Spectroscope and Microspectroscope in the Discovery of Blood-stains. By Dr. Herapath	Ditto.
The Works of W. Hewson, F.R.S.	G. Gulliver, F.R.S.
Portrait of Professor Owen	Professor Owen.
Album of Portraits of Fellows	Messrs. Maul.
Schacht on the Microscope	Henry Lee.
Ray Society's Volume for 1867	Ditto.

A paper was read by Major Ross, R.A., "On Micro-crystals and Iridescent Films obtained by the use of the Blow-pipe." Major Ross showed his method of operation. He melted borax on a platina wire bent into a ring at one extremity, and then introduced the various metals. By employing a mechanical blow-pipe to maintain the borax bead in fusion, he was able to blow it into a thin bubble by means of an ordinary mouth blow-pipe. The borax bubbles exhibited iridescent colours, and after being left for some sime undisturbed micro-crystals made their appearance. Major Ross thought that the colours of the films and the forms of

the crystals were characteristic of the particular metals or other bodies fused with the borax. He then described at length the beautiful effects produced, and gave theoretical explanations of the phenomena.

Before this paper was read the PRESIDENT stated that, as Major Ross was about to leave London, he had consented to its being brought before the Society, although the Council had not had an opportunity of seeing it. Under these circumstances they would exercise their discretion as to its publication.

Mr. BROOKE, F.R.S., remarked that the author had not discriminated between two distinct phenomena in optics, refraction and interference. He also referred to the attempts made by Newton (to which Major Ross alluded) to explain the colours of films by his corpuscular emission theory of light. The colours in Major Ross's experiments were entirely produced by the well-known action of films, and were perfectly accounted for by the undulatory theory.

Mr. JABEZ HOGG thought that inferring the composition of bodies from special forms of micro-crystals would easily lead to error. Mr. Waddington had shown him specimens of micro-crystals resembling those obtained in Dr. Guy's sublimations, and showing the uncertainty of that class of evidence.

Mr. SLACK, while differing entirely from the theoretical portions of Major Ross's paper, was of opinion that he had indicated an interesting field of research, in which facts of importance might be discovered.

In reply to observations of Major Ross, Mr. BROOKE explained that, although various forms might be obtained from a crystallizable body by crystallizing it under different conditions, they would all be referred to the same system.

Mr. HOGG then read a paper on "The Lingual Membrane of Mollusca, and its Value in Classification." (See 'Trans.,' p. 93.)

At the close of the above paper Mr. HOGG pointed out the advantage of mounting palates in glycerine. He found that Canada balsam materially damaged the delicate portions of the structure.

The Rev. THOS. H. BROWNE asked if Mr. Hogg thought "lingual" a proper term for all the structures to which it was applied. He considered that it should be restricted to palates in which one portion was detached and capable of protrusion. The best way to see the form of lingual teeth was to tear the palate from the outside towards the centre.

Mr. HOGG thought Huxley's term odontophore preferable to lingual membrane.

SOIRÉE, *Wednesday Evening, April 22nd.*

THE invitations issued by the President and Council were generally responded to, and the soirée was attended by upwards of 1300 visitors and Fellows. By the courtesy of the authorities

of King's College the whole building was thrown open on this occasion, including the Museum of George III and the Natural History Museum, the interesting contents of which were a great source of attraction, and contributed to prevent the large hall and libraries from being overcrowded. The refreshment department, which proved insufficient on former occasions, was conducted this year on a much larger scale, an additional room having been assigned to it, and nothing omitted that could promote the comfort of the visitors. The exhibition of objects of beauty and interest was such as not only to afford satisfaction to the Society and their guests, but also to create a belief that the interest for microscopical research is greatly on the increase.

There was, on the whole, a larger display of microscopes of every description than usual, contributed by nearly all of the London makers—Messrs. Ross, Messrs. Beck, Messrs. Powell and Lealand, Mr. Ladd, Mr. Baker, Messrs. Murray and Heath, Horne and Thornwaite, J. How, Crouch, Swift, Browning, Collins, Norman, Wheeler, Salmon, &c. &c.

The collection of old microscopes, superintended by Mr. Williams, occupied one of the most attractive tables of the exhibition. Under the Martin's microscope a splendid crystallized mass of bismuth, with iridescent colours, formed a most splendid object, while it demonstrated the large field and power of this remarkable instrument. There was also the microscope made for George III, with other curious early microscopes. A new reflecting goniometer was shown by Mr. Browning, as well as a number of spectroscopes. The absorption bands of the red feather of the *Turacus albo-cristatus*, in which Professor Church discovered the red organic pigment *turacine*, containing copper, were exhibited by Mr. Browning, and the structure of the feather was shown by Mr. Slack. The platform was occupied by Dr. Carpenter and Mr. Henry Lee, the former bringing a beautiful collection to illustrate the structure of the Ophiuridæ, and the latter exhibiting a selection of objects from the Paris Exhibition, and some elegant drawings of snow crystals on the squares of a chess board.

Mr. Ladd's exceedingly fine specimens of Iceland spar were a source of much attraction; and under one of his microscopes a "spirally crystallized sulphate of copper." This salt, it appears, when permitted to crystallize from warm solutions, assumes, according to the temperature, a spiral appearance, as though the solution during the process of cooling had been full of minute whirlpools, or rather had taken on a rotatory motion. In this state it becomes an attractive object for polarized light. Mr. W. S. Waddington showed a beautiful and interesting series of micro-sublimates; and in one of the lecture-rooms Mr. How, by the aid of the oxy-hydrogen light, exhibited at intervals a series of Dr. Maddox's micro-photographs, and a superb collection of photographs from various parts of Europe. Mr. How's kaleidoscope, applied to the gas microscope, was also much admired.

Mr. Hopkinson's collection of fossils, among which we noticed

a remarkable specimen of *Diplograpsus angustifolius*, Hall, in which the prolonged axis is enveloped in a non-celliferous portion of the periderm; also a series of fossil woods illustrative of Mr. Carruther's paper in the 'Intellectual Observer,' May and June, 1867.

Under the Society's microscopes were shown an interesting series of objects from the Wallich and Beck collections, and objects presented by T. Ross, Dr. Carpenter, and T. White. A series of bronzes reduced to scale from the antique, by Mr. Flaxman Spurrell, were much admired, as also were a series of drawings of the British mosses by Dr. Braithwaite, and another series of tongues of mollusca illustrative of Mr. Hogg's paper, a fine set of coloured figures of fungi by G. W. Smith, and micro-photographs by Dr. Millar.

It would occupy too much space to particularise all the objects of novelty, but we must mention Mr. Ross's new four-inch objective, and his tank microscope; Ackland's alcohol thermometers, graduated on an entirely new plan to ensure accuracy; a new form of Reade's double hemispherical condenser; Fiddian's lamp chimney, by Mr. Collins; a new meteor-spectroscope, with an enormous field, by Mr. Browning; an improvement on Nachet's stereo-pseudoscopic microscope, by Messrs. Murray and Heath; a pocket microscope by ditto; a travelling microscope by Mr. Moginnie, &c.

May 13*th*, 1868.

James Glaisher, Esq., F.R.S., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were duly elected Fellows of the Society:—Arthur E. Durham, F.R.C.S., &c.; Charles S. Baker; Dr. Edward Dowson.

The following donations were announced, and thanks returned to the respective donors:

	Presented by
A $\frac{1}{20}$th Object-glass	J. Smith, Jun.
A Condenser, with Polariscope, &c.	J. Swift.
Adams on the Microscope, 2nd edition	R. Farmer.
Catalogue of Royal Society's Papers, vol. 1	Society.
Six Slides of Podura Scales	S. J. M'Intire.
Land and Water (weekly)	Editor.
Journal of Society of Arts	Society.
Photographic Journal	Editor.
Journal of Linnean Society	Society.
Journal of Geological Society	Society.
Portrait of Charles Brooke, Esq., F.R.S., &c.	C. Brooke, Esq.
The Student	Publisher.
Untersuchungen ueber Entwickelungsgeschichte des Farbstoffes in Pflanzenzellen, von Dr. Adolf Weiss, 2 Parts	Author.

	Presented by
Beitrag zu einer Monographie der Sciarinen, von Joh. Winnertz in Crefeld . . .	Author.
The Microscope, 4th edition, by Dr. Carpenter .	Ditto.
Die Diatomeen der Hohen Satra bearbeit, von J. Schumann	Ditto.
Diagnosen der in Ungarn und Sclavonien Bisher Beobachteten Gefässpflanzen, Verhandlungen der kaiserlich-königlichen Zoologisch-botanischen Gesellschaft in Wien	Ditto.

The attention of the Society was called to a set of models of the gizzard of the *Philodina roseola*, made by the Hon. and Rev. the Lord Sydney Godolphin Osborne.

Mr. Heisch read a description of improvements he had effected in Nachet's Stereo-pseudoscopic Binocular Microscope. (See 'Trans.,' p. 112.)

Mr. Brooke explained the action of Nachet's construction.

A paper was then read "On Fungoid Growths in Aqueous Solutions of Silica, and their Artificial Fossilization," by William Chandler Roberts, F.C.S., Associate of the Royal School of Mines, and Henry J. Slack, F.G.S., Sec. R.M.S. (See 'Trans.,' p. 105.)

Mr. Roberts gave some further account of the mode of preparing silica solutions and their behaviour.

Mr. Barff, F.C.S., stated that, in his experiments referred to in the paper, every care was taken to exclude dust. The silica solution was dialysed in a vegetable parchment dialyser covered with filtering paper. After the potash and acid had passed away, the solution of silica was filtered. Some growths were found on the filter, and growths came abundantly in the solutions kept in University College Laboratory. Some gelatinized specimens contain dozens of the fungoid plants. As the gelatinized silica dries, the process does not seem to go on by steady evaporation. He had observed a layer of water on the top of some silica in a flask, as if it had been squeezed out from the mass below. Peculiarities in the mode of drying might account for the fungoid branches keeping their form during the contraction of solidification. From some experiments he thought that the presence of alkalies prevented these fungoid growths. Where the growths had occurred the plants had no nutriment but what they might derive from silica, air, and water. He thought further observations might lead to a better understanding of the part played by silica in agriculture. He considered that the importance of silica had not been fully recognised hitherto.

Mr. Browning said that he had heard the vegetable appearance compared with the peculiar fractures produced by electrical perforations in glass, but their actual growth was conclusive as to their character.

Mr. Slack observed that the foliated aspect of glass perforations

did not look like vegetation when properly examined, but did resemble certain mineral crystallizations.

The Rev. J. B. Reade said he had been struck with the important part played by silica in many plants. It was not confined to cuticles of straw, &c., and was deposited as part of a true process of growth. He inquired whether any carbon had been detected in the artificial fossils of moulds.

Mr. Roberts replied that the quantity was probably too small; that Mr. Slack and himself had obtained a carbonaceous appearance by heating mycelium threads, taken from silica solutions, in hot sulphuric acid; nitric, hydrochloric, and nitro-hydrochloric acids, even when hot, acted slowly upon them.

A paper was then read "On a New Form of Condenser with a Blue Tinted Field Lens," by W. H. Hall, Esq., F.R.M.S. (See 'Trans.,' p. 108.)

Mr. Hall presented to the Society, on behalf of Mr. Swift, a condenser and paraboloid, made according to his pattern.

The thanks of the Society were unanimously voted to Mr. Swift.

The meeting was then made special, and the following amendments of the Bye-Laws unanimously passed:

Proposed by the Rev. J. B. Reade, seconded by Mr. Lee—

"That Bye-Law Sec. 2, No. 7, shall be amended by the addition of the following words, viz.—'That, at the death of any compounder, the fee paid by him for his composition may, by the direction of the Council, be released from such investment, and applied as the Council may think fit.'"

Proposed by Dr. Millar, seconded by Chas. Brooke, Esq.—

"That, for the future, Sec. 2, No. 14, shall be as follows, viz.—'Any Fellow who may be absent from the United Kingdom during the space of one year, or who may permanently reside out of the said kingdom, may, upon notifying such fact to the Secretaries in writing, be exempted from paying one half of the annual subscription of £2 2*s.* so long as his absence may continue. The publications due to Fellows residing out of the kingdom (Honorary Fellows excepted) shall be delivered to such agent in London as they may appoint.'"

June 10*th*, 1868.

James Glaisher, Esq., F.R.S., President, in the Chair.

The following gentlemen were duly elected Fellows of the Society:—Robert Luke Howard; Joseph Russell; Edward Davy Harrop.

The President announced that the Reading-room would be closed during the month of August, but, with that exception, it could be used by Fellows in the recess.

The following donations were announced, and thanks returned to the respective donors:

	Presented by
Slide of Spiral Sulphate of Copper	Mr. Ladd.
Journal of Linnean Society	Society.
Canadian Journal, No. 66	Institute.
Photographic Journal	Editor.
The Student	Publisher.
Micro-sublimation, by H. J. Waddington	Author.
Proceedings of the Academy of Sciences of Philadelphia, 4 Parts	Academy.
Abhanlungen herausgegeben von Naturwissenschaftlichen Vereine zu Bremen, 1868	
Land and Water (weekly)	Editor.
Journal of Society of Arts	Society.
Portrait of James Bowerbank, Esq., F.R.S., &c.	J. Bowerbank.
Report of Board of Health on Cholera Epidemic of 1854	Jabez Hogg.
Annals of Natural History	Purchased.

The Secretary described "A Reversible Compressorium, with a Revolving Disk," designed by S. Piper, F.R.M.S. (See p. 114.)

Dr. Thudichum delivered an interesting address "On the Relation of Microscopic Fungi to Pathological Processes, particularly the Process of Cholera." He proceeded to a critical examination of the latest inquiries of Klob, Thomé, Hallier, &c., all of whom attribute the symptoms of cholera to a "*fungus contagium*," and which they say can be found in all the excretory fluids of persons affected with this disease. Their so-called "micrococci," which, as they suppose, destroy the villi of the intestines with much rapidity, were, in Dr. Thudichum's opinion, the results of granular disintegration, and could be met with in all albuminous and nitrogenous matters after standing a few hours. As to the "cylindriform fungi" of Klob, they were not fungi at all, but bodies termed "vibriones," which rapidly multiply by self-division, and when present have nothing whatsoever specifically to do with the cause of cholera.

Mr. Hogg highly eulogised the scientific and valuable labours of Dr. Thudichum, and observed that the subject offered an attractive and promising field of research for the Fellows of the Society, skilled, as most of them were, in the use of the microscope. He quite concurred in the views expressed by Dr. Thudichum; and Dr. Hassall, who during the epidemic visitation of 1854 made twenty-five examinations of the rice-water discharges, stated "that in none could he find either sporules, threads, or any species of fungus." In some, however, after standing by for a space of twenty-four hours, he observed "myriads of vibriones." A full account of these examinations, with illustrations, appeared in the 'Annual Report of the Board of Health' of the period, a copy of which Mr. Hogg had much pleasure in presenting to the Society. He would also direct attention to the valuable researches of Dr. Thudichum on this subject, published in the 'Blue Book' of last year. In this report Dr. Thudichum shows, by the aid of

micro-spectroscopy, that a marked alteration of the blood takes place during the progress of choleraic disease.

The PRESIDENT, upon rising to propose a vote of thanks to Dr. Thudichum, expressed the great pleasure with which he had listened to his interesting remarks, and repeated that the "blue mist," which he had described as being present during a cholera visitation, had been visible during the past fortnight, but with special differences in its appearance from that presented during the prevalence of the disease.

A special vote of thanks was accorded to Mr. Bailey and Mr. Collins for services rendered at the last soirée, which brought the work of the session to a close.

QUEKETT MICROSCOPICAL CLUB.

March 27th, 1868.

Dr. TILBURY FOX, Vice-President, in the Chair.

Mr. Curties read a paper by Mr. Tatem on "Some Rare and Undescribed Species of Infusoria."

Mr. R. T. Lewis read a paper on "The Application of Berlin Black to Microscopical Purposes."

Mr. S. J. M'Intire read a paper on "Some Cheap Aids to Microscopical Study."

According to notice given, the meeting was made special to consider the following proposition:—"That ladies be permitted to become members of the Club, and that such alterations in the rules be made as may be necessary to effect this object;" which, on being put from the chair, was negatived.

Fifteen members were elected.

April 24th, 1868.

Mr. ARTHUR E. DURHAM, F.L.S., President, in the Chair.

Dr. Braithwaite read a paper on "The Mosses gathered at a recent Excursion of the Club," illustrated by a collection of dried specimens and numerous drawings, which he presented to the Club as the first of a series of mosses found in the metropolitan district.

Mr. S. J. M'Intire read a paper entitled "Some Additional Notes on Poduræ."

Twelve members were elected.

May 22nd, 1868.

Mr. ARTHUR E. DURHAM, F.L.S., President, in the Chair.

Mr. James Martin read a paper on "The Crystallization of

Sulphate of Copper at different Temperatures," and exhibited a series of specimens under the microscope.

Mr. J. Slade read a paper on "The Microscopic Structure of the Shells of Crustacea," which he illustrated with several coloured diagrams.

Dr. Braithwaite presented specimens of mosses in continuation of the series, and called attention to four as being rare, viz. *Fissidens exilis*, found by Mr. W. W. Reeves; *Hypnum impotens* and *Buxbaumia aphylla*, found by Professor Lawson; and *Hypnum Illecebrum*, found by Dr. Braithwaite, who also exhibited specimens of *Wolffia arhiza*, the smallest of the British flowering plants, and recently discovered here.

Thirty members were elected.

Dublin Microscopical Club,

16*th January*, 1868.

Dr. Moore, alluding to the exhibition at last meeting of the Protonema of *Schistostega osmundacea*, by Dr. Dickson, brought forward a frond of this little moss, which he had in cultivation, forming a very pretty low-power object.

Rev. E. O'Meara exhibited a new Navicula, to be hereafter described.

Rev. T. G. Stokes exhibited a fine specimen of *Actinoptycus tricingulus;* also, on the same slide, a test of a Difflugia obtained from guano, which had withstood the action of the acid used in the preparation of the diatoms. This was a balloon-shaped pellucid form, externally marked by reticulations.

Dr. Collis exhibited sections of a wart, which was passing into cancerous degeneration. The sections showed the first two stages of this degeneration, and corresponded with wonderful accuracy to some diagrams on the subject which had appeared in his work on 'Cancer and Tumours.' In one portion of the section, the cutaneous papillæ were seen in a state of simple hypertrophy, with the epithelial covering lying in a dense horny mass upon the surface of each papilla, and crowded irregularly in the interspaces between the papillæ. In a neighbouring part, the horny epidermis had encroached on some of the papillæ, and, by its pressure, produced ulcerative absorption of them. Traces even of the third stage, or interstitial deposit of the eperdermic scales in the substance of the skin, could be faintly made out in some points. The difference of colour and of refractive power in the true skin and the epidermis brought out these points with more than usual sharpness.

20*th February*, 1868.

Dr. John Barker mentioned his having seen in "conjugation" that minute rhizopod *Trinema acinus*, and described the alternate

transference of the granular contents to take place quite in the same manner as previously referred to by Mr. Archer in one or two species of Difflugia.

Rev. E. O'Meara exhibited *Surirella reniforme.*

Mr. Archer exhibited a couple of instances of the conjugated state of the common and widely-distributed diatom, *Stauroneis phœnicenteron,* the more interesting as being for the first time seen seemingly in any species of that genus. The process in the form shown is, however, nearly a complete parallel to the mode of conjugation described by Carter for *Navicula serians* ('Ann. Nat. Hist.,' V. xv., N.S., p. 161. Pl. iv, f. 7); at least, this might be said for it so far as could be gathered from the present specimens, which were in such a condition that the process was quite completed, and the so-called "sporangial frustule," more properly regarded rather as simply the first ordinary frustule of a new cycle, was fully formed. The main point of difference was that seemingly there was but one young frustule produced, not two, as in *Navicula serians.* Another distinction, of less importance, was that the secondary coverings of the new frustule were neither so numerously nor so distinctly marked by annular ribs—these were much fewer than depicted by Carter, and confined to the middle, the ends being without these transverse markings. The "Caps," or hemispheres, of what ought seemingly to be called the Zygospore, were present, and borne aloft, as in *N. serians,* by the new large young frustule. As in Navicula, the conjugating frustules were very small, the resultant frustule evolved from the *Zygospore* being twice the linear dimensions in every way of the former. But one meets this and other forms, as is well known, of many various dimensions, and the young frustules were in every respect perfectly similar to all those of the same species around, save in size merely. It is, perhaps, curious that this almost cosmopolitan species should never before have been met with conjugated; that fact would, however, render the present specimens the more interesting.

Dr. Purser showed specimens of the goblet-shaped epithelial cells ("Becherzellen" of the Germans) from the small intestine of the cat, and he made some remarks on the structure and probable function of the unicellular glands for the secretion of mucus.

Capt. Crozier showed some elegant diatoms; amongst others *Mastoglœa elegans, Cymboseira impressa,* &c.

Dr. Macalister showed *Docophorus semisignatus,* a parasite of the Raven.

Mr. Archer likewise drew attention to a characteristic recent specimen of the new Rhizopod, *Clathrulina elegans* (Cienskowski), showing the encysted condition as in that observer's plate, fig. 6, being that state which Mr. Archer had once imagined to represent a "central capsule," comparable to that of the marine Radiolaria of Häckel. Mr. Archer had only once before been able to show a specimen of this creature to the club, and it was not in the encysted state, but with the sarcode body in the ordinary condition.

Resolved, that the members of the club desire to place on record their unfeigned regret at the loss to science and to the club, caused by the death of their lamented friend, and respected and esteemed honorary member, the late Admiral Jones, F.L.S.

19*th March*, 1868.

Rev. Eugene O'Meara exhibited *Navicula zanzibarica* from Dr. E. Perceval Wright's collections at the Seychelles.

Rev. E. O'Meara likewise exhibited a new species of Actinocyclus given to him by the Rev. T. G. Stokes. The following is an extract from a communication from the latter gentleman:

"I have been for some time engaged in examining a quantity of Haliotis shell cleanings, and, owing to the great number of sponge spicules, found it necessary to mount the diatoms by the method of selection, using a simple microscope. There were in it three or four forms similar to that which I send. Dr. Greville, a short time before his death, sent me a slide from a Californian gathering, containing three or four frustules of this species. He named it provisionally Actinocyclus, but was so uncertain as to the genus, that he was unwilling to give it any specific name. Had he seen it, as I have, floating in fluid, inclined at various angles to the axis of vision, and exhibiting, even under a simple microscope, the characteristics of the genus, his opinion would have been confirmed. This form is not extremely rare, but it is far from common. Under a low power, when at rest, this diatom appears like a plain yellow disc, but when examined under a high power, the radiating lines and submarginal pseudonodule are visible, as well as fine transverse markings, similar to those on *Triceratium marylandicum*."

Mr. Archer exhibited a couple of authentic specimens of *Micrasterias Hermanniana* (Reinsch), as well as that author's figure of the same, in his "Algenflora des mittleren Theiles von Franken," t. viii, fig 1. He also showed Grunow's figure of his *Micrasterias Wallichii*, given in his paper in Rabenhorst's 'Beiträge zur naheren Kenntniss und Verbreitung der Algen,' t. ii, fig. 21, and this in order, whilst pointing out their great resemblance, to which Reinsch does not allude, to indicate that they may be nevertheless quite distinct. *M. Wallichii* (Grunow) is furnished with an inflation at the base of the segments, which does not seem to exist in *M. Hermanniana*, and the ultimate lobes of the former are not so slender as in the latter. Yet they seem to resemble each other quite as much, or more, than many of our common and familiar home forms, which, however, Reinsch himself would combine as single species, but still, if we were equally well acquainted with the two forms in question, we should, perhaps, just as readily see that they were truly distinct. But, be it as it may eventually turn out, the two figures are worthy of comparison by those interested in these forms.

Rev. E. O'Meara read some remarks in reply to a communication

from Mr. Kitton in preceding number of this Journal, animadverting on new species of Diatomacæ described by the former gentleman, and which has already appeared in the last number.

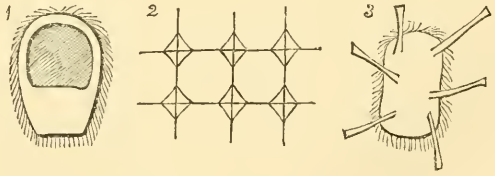
Royal College *of* Surgeons, Hunterian Lectures *on the* Invertebrata. By Prof. T. H. Huxley, F.R.S. (Abstract.)

(*Continued from page* 129.)

Lecture III.—The Monerozoa include besides the Foraminifera and Protogenes, other forms in which there is a marked advance in structure. The Amœbæ generally, which used to be classed as *Rhizopoda lobosa,* belong here, and present a nucleus and contractile vesicle. Professor Huxley doubts as to whether the contractile vesicle has a permanent opening. The Amœbæ multiply by fission, and also present an approach to a sexual mode of reproduction. The Amœba becomes quiescent, and perhaps encysted, when the nucleus splits up into several pieces, each of which becomes surrounded by a definite mass of the parent Amœba's sarcode substance, and each when set free becomes a new and very small Amœba. The next step onwards in structure is found in the Gregarinæ. These organisms are all internally parasitic. No distinct cuticular membrance is to be traced in normal individuals, but the outermost part of the jelly-like substance of which the animal consists is denser than the rest, more or less, and forms a sort of cortical substance. The inner and more liquid material contains innumerable coarse granules, and a clear vesicular body or nucleus. No pseudopodia are ever extruded by these animals. They live by imbibition, being continually bathed in a nutritious broth formed for them by the animal they infest. They reproduce by a breaking up into bodies called *pseudo-naviculæ.* These *pseudo-naviculæ,* which are formed by encysted Gregarinæ, give rise to Amœba forms which become Gregarinæ. One Gregarina can alone produce *pseudo-naviculæ,* at the same time Professor Huxley considers that the analogies of this process with the conjugation of Algæ should be borne in mind. It is noteworthy that the younger Gregarinæ have almost no granular matter, and are by far more active than the larger specimens. The Foraminifera, with Protogenes, Lieberkuhnia, &c., the Amœbæ and the Gregarniæ, form the group *Monerozoa.* The *Radiolaria* form the second group of the Protozoa. Professor Huxley, in his voyage in the

Rattlesnake, observed the jelly-like spiculated masses to which he gave the name Thalassicolla. Johannes Müller subsequently showed that they had been observed by Meyen, and he himself studied them. But it is to his pupil, Professor Häckel of Jena, that we owe our knowledge of the group. He has published a very large work on them, illustrated with most beautiful coloured figures (1862). Ehrenberg described the siliceous shells of many of these Radiolaria as Polycystina. A Radiolarian consists of a rounded mass of sarcode, capable of extruding pseudopodia (which Professor Huxley confessed he had missed in his examinations on board ship); in this are scattered numerous yellow cells, probably, as Häckel says, acting the part of liver, as we see also in Hydrozoa. In the midst of this is a sac with granules, and a clear nucleus, sometimes containing also curious crystals of sulphate of lime. In addition to this, we may have a skeleton, composed either of scattered spiculæ, (*Sphœrozoum*), or a complete enclosing basket-work (Polycystina), or radiating siliceous rods (*Acanthometra*). These skeletons, which are siliceous, have the most wonderfully beautiful forms, and all this modelling force exists in a mass of homogeneous jelly! Some Radiolaria are aggregated into masses, as Sphœrozoum, others are single. Their reproduction is but little known. Division has been observed, but no sexual process. In some respects the Radiolaria lead to the Sponges, although perhaps they ought to be regarded rather as a terminal group than as leading anywhere. They are to a small extent rock-makers: as we see in the celebrated Barbadoes earth, which contains Polycystina.

Spongiadæ.—The structure of Spongilla was described (see Lectures on Classification, p. 14) as a type. The sponges are to be regarded as aggregations of Amœboid animals. The ova and spermatozoa are developed in any part of the sponge, and the ciliated embryo, which is produced, encloses the germ or future sponge (fig. 1). It is



not known if yelk division takes place. The sponges fall into five groups. (1.) *Halisarcidæ*—very simple forms, with no spicula; the presence of water canals not ascertained.

(2.) *Clionidæ*—the perforating sponges; they use their spicula for perforating; each species makes a pattern of its own like the leaf-burrowing caterpillars. Silurian species have been observed. (3.) *Spongidæ*—having the structure of Spongilla. Fritz Müller has lately described (see Quart. Chronicle, vol. for 1866) a genus Darwinella, which has horny spicula as well as horny fibres building up its skeleton. Some sponges have very few spicula, and are then used for washing, &c. *Grantia* has calcareous spicula, which are very long, and placed round the apertures. They are the nearest approach to the enormously long siliceous spicula of *Hyalonema* from Japan. Professor Huxley fully supported Max Schultze's view of the parasitic nature of the Actinozoon found at the base of *Hyalonema*. (4.) *Petrospongidæ*—abound in the chalk: such forms as Ventriculites, &c. They have a peculiar arrangement of the fibres of their skeleton (fig. 2). They are doubtfully placed among the sponges. (5.) *Tethyadæ*—large spheroid bodies with huge spicula radiating from the centre; sometimes provided with anchors at their ends. Their sexual condition has been well studied.

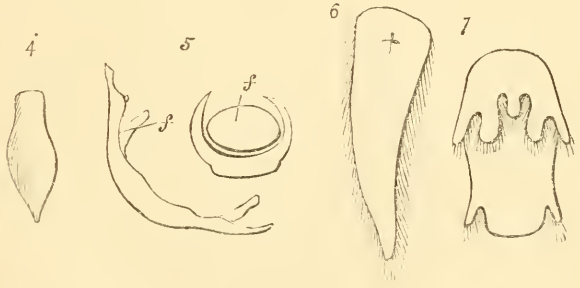
Lecture IV.—The *Infusoria* seem to stand between Protozoa and Annuloida. *Paramæcium* was described as in former lectures, as a type. (See Lect. on Classif., 1865.) A distinct cuticula was admitted for the Infusoria, which is *continuous* with the cilia. The mouth leading into the semi-liquid substance of the body, and the appearance of pellets of food surrounded by water when taken in, were described. Professor Ehrenberg still retains his view as to plurality of stomachs (*Polygastrica*), being "a man who does not give up an opinion which he has once adopted." The cause of the slow rotation of the food within Infusoria is still unknown. Professor Huxley compared it to the circulation in Anacharis and Valisneria. A distinct anal aperture is now admitted to exist in Infusoria, which can only be detected when matter is being expelled from it. The chlorophyl granules which abound in some Infusoria are admitted by Professor Huxley to be formed in all probability by the animal itself. He also adopts the view that the contractile vesicles have a permanent communication with the exterior. The notion that Infusoria are unicellular organisms has had to be considerably modified. Their so-called nucleus is only in a limited sense to be regarded as a nucleus; it is in another sense an ovary. Müller, Claparède, Balbiani, and lastly, Stein, in his second great book lately published, have contributed to our knowledge of sexual reproduction in Infusoria. Balbiani showed that what Müller took to be a

process of fission, was really the result of the conjunction of two infusors, which he maintained exchanged spermatic elements (nucleoli). Stein now denies the exchange, but maintains that the conjugation merely gives a stimulus to the development of the sexual organs. Professor Huxley thinks that, at first sight, Balbiani's is the more likely view. The nucleus, at any rate, splits up, and each piece becomes an embryo—not acting therefore like a true ovary, but in a measure like the nucleus of a cell. The embryo so formed is a ciliated creature, with long sucker-like pseudopodia; it is what is called the *Acineta-form* (fig. 3). There are four definite modifications of the Infusorian type, illustrated respectively by—(1.) Paramœcium and the free forms. (2.) Vorticella and the stalked forms, in which the cilia are confined to a double row on the "head," one row on each side the crescent-shaped oval aperture. The stem of Vorticella contains a true muscular fibre. No nucleoli or testes have ever been detected in Vorticellæ, and Stein maintains that the little fellows hanging on to large Vorticellæ, which used to be thought "buds," are really the male forms conjugating (as do two Paramæcia), and that they are ultimately absorbed into the larger individual. The view which Stein put forward as to the connection of Vorticella, Acineta, and Actinophrys, he has now withdrawn. It is quite erroneous. (3.) *Acineta* and *Podophrys*. These are most remarkable as presenting permanently (?) the condition of young Infusoria. The hollow sucker-like pseudopodia in them take the place of a mouth. They are in fact "polystomatous." (4.) Noctiluca. Häckel very erroneously places this animal with his Protista. It is difficult to put it anywhere, but Professor Huxley prefers to place it here. De Quatrefages has shown that it is the granules of the superficial layer that give rise to the light. Noctiluca is like a reticulate monerozoon placed quite within a peach-shaped capsule, to which is attached the tail-like process, and in which is the mouth, its horny ring, and cilium-like tongue. (See papers in this Journal by Professor Huxley and others.)

The *Annuloida* have their tissues differentiated into cellular elements. They exhibit a Bilateral and often a successional symmetry of parts (contrasting in this with Infusoria). They never have a chain of ganglia. They all have the water-vascular system. Two groups may be distinguished among them, the Scolecida and the Echinodermata. The Rotifera form a good commencement for the study of the Scolecida as they present the typical structure. The cuticle of the Rotifera is more or less chitinous; the body is faintly annulated. At

the anterior end is the trochal disc, a ciliated expanse varying in its structure; at the anal end there is often a pair of pincers; there may be, however, no apendages at all. The mouth leads into a proventriculus or gizzard provided with a chitinous crushing apparatus; the intestine which follows is large but straight and simple. In *Hydatina*, a pair of glands called by Ehrenberg "pancreas" open into the alimentary canal. From the cloaca proceed two long tubes which coil up the sides of the body, and each give off four delicate branches terminating by ciliated trumpet-shaped organs hanging freely in the perivisceral fluid. These form the water-vascular system which is the great characteristic of the Scolecida. The generative organs are simple enough, consisting in the female of a simple ovary opening into the cloaca; in the male, which is much smaller than the female, and destitute of alimentary apparatus, a testis and penis are found.

Lecture V.—The Scolecida include the following groups in addition to the Rotifera, the Trematoidea, and Turbellaria, the Cestoidea, and Acanthocephala, the Nematoidea and Gordiacea. The Trematods have no proper perivisceral cavity, that is to say, instead of a corpusculated fluid, there is a cellular tissue. The details of structure of *Aspidogaster* were given (see former lectures). The existence of a germarium and of a vitellarium was especially noticed—it being possible for the impregnation of the ova to be effected before the accessory yolk from the vitellarium was poured round it. The integument of *Fasciola* presents numerous lancet-like bodies of a chitinous material, which aid it in progression, and call to mind the bodies in the integument of some other Scolecida (fig. 4).



The alimentary canal is in Trematods a blind sac, either single or double, or, as in *Fasciola*, much branched. The water-vascular system, essentially as in *Aspidogaster*, varies as to the presence or absence of a pyriform sac. In the flukes

there is a median dorsal vessel which is not ciliated. *Distoma Okeni* and *Bilharzia hæmatobium* are the only Trematods of distinct sexes. The latter is a dangerous parasite of Egypt, causing the death of hundreds of the poorer class. The male permanently embraces the female, so that they present through life this appearance (fig. 5). No complete case of Trematod development is yet known. Leuckhart has found that the common Fluke gives rise to a ciliated larva (fig. 6), but he has been unable to trace it further. But by comparing the *Monostonum* of birds, the *Redia* and *Cercaria* of water-snails, which subsequently become encysted, and give rise to a Distoma, we are able to frame some notion of the order of development. It is evident that two hosts are necessary, of which the second is nearly always higher in the animal series than the first. We get, then, the following order:—1. Ciliated embryo; 2. Redia, which may produce other Rediæ by internal budding, but eventually produces, 3. Cercariæ, which become encysted, and emerge, as 4. Distomata, which lay eggs. In some cases the Rediæ are simple oval masses, and are then called Sporocysts. In the fresh-water Mussel, a form of Cercaria is found which has not yet been traced out; it has two long tails instead of one, and is known as *Bucephalus*. *Diplozoon* is a Trematod; the individuals are hatched separately, but come together and fuse or conjugate as in the Infusoria, and then the sexual organs develop.

Lecture VI.—The Turbellaria are very near to the Trematoidea, but none are parasitic, they never have prehensile hooks as some Trematods do, nor any suckers. In the integument are bodies resembling thread-cells and aciculi. The alimentary canal exhibits the simple and the branched form, as in the types *Nemertes, Opisthomum,* and *Polycelis*. The proboscis, which some Nemertians have in front of the mouth, but usually packed in the body-cavity, is a very remarkable structure. The water-vascular system in some has more than one pore. In Nemertians it is open when young, but in adults it is closed definitely, forming a contractile system of vessels like that of Annelida. The nervous system consists of a couple of ganglia, giving off two long stems, but there is no gangliated chain. The reproductive organs present two extremes of complexity; in Nemertians they are simple masses which escape by dehiscence, the sexes being distinct; in Planarians they are as complicated with accessory parts, &c., as in any group of animals. The development of Turbellarians presents many points of interest, and is not yet known in more than a few forms. A certain species of *Planaria* presents a larva of the form in fig. 12, presenting

two ciliated ridges produced into well-marked processes. These subsequently shrink up, and the animal becomes a simple Planaria; the resemblance to some Echinoderm larvæ in this form is striking. In a *Nemertes*, a larval form which has been named Pilidium is produced, in the interior of which the young worm develops, enclosing the alimentary canal of the larva, and finally escaping from it, leaving the rest of the larva to perish. This is identical with what goes on in some Echinoderms. The Cestoidea are represented by the common Tape-worm. When in its habitual haunts, the tape-worm is quite an active creature, exhibiting considerable power of movement. The head presents two rows of hooks and four suckers. A circular vessel exists in the head from which proceed four longitudinal stems, the branches of which are ciliated; they open together by a terminal pore at the last joint, the canals of each joint being connected to those of the succeeding joint by such a pore. It is said that a nerve-ganglion exists in the head of Tænia, but this appears very doubtful. In the integument are minute oval bodies, variously dispersed. They are the so-called "calcareous corpuscles," but are by no means always calcareous. It is suggested that these corpuscles are at the extremities of fine branches of the water-vascular system, and are composed of Guanin (an effete product allied to uric acid), since such bodies have been found in the vessels of Distomata, where Guanin also has been detected. Each segment of the tape-worm is hermaphrodite, and has its genital pore. The organs are arranged essentially on the Trematod plan — a penis, testicular sacs, vagina, ovarium, germarium, and great uterine chamber. The penis has been continually seen to pass into the vagina of the same joint, whence self-impregnation has been inferred but not proved.

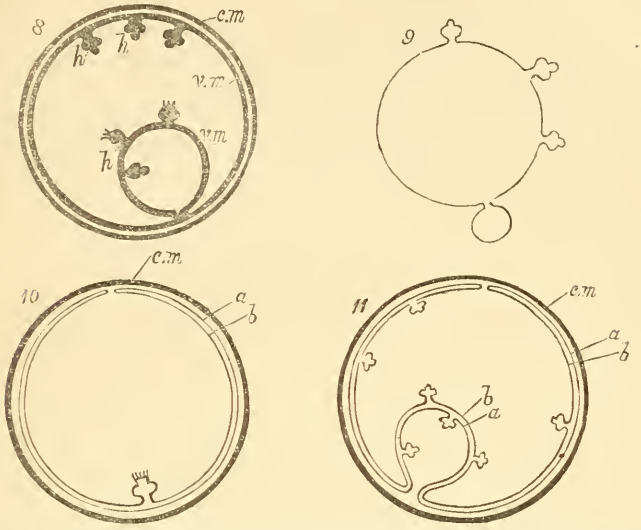
Two hosts are not *necessary* for the tape-worm. A man who swallowed the joint of a *Tænia solium* would have the eggs hatch in his stomach, and make their way into his muscles. There they would assume the hydatid form, and when this man was eaten by another (for men were undoubtedly cannibals in the earlier periods), the head of the hydatid would give rise to a tape-worm. Usually, now-a-days, the pig or ox hatch the tape-worm's eggs for us. The larva has a bilateral symmetry, with three pairs of hooks. On being carried by the blood into the muscular tissue it assumes the pupal condition, developing into a large sac, in an involution of which the head appears growing inwards until by pressure it is forced inside out. The terms larva, pupa, and imago may be fairly used in this case. The pupa

or hydatid is to be regarded, as Siebold says, as an abnormal dropsical condition; the creature has lost its way, as it were, and is waiting to be removed by the mastication of some carnivorous animal. The restriction of the existence of species of tape-worm to certain stomachs is very noticeable. The pig's stomach will not support its (the human) cysticerci.

Lecture VII.—Van Beneden's classification of Cestoidea was considered very good by Professor Huxley. 1. Caryophyllidea: simple forms found in the carp, of only one joint and an unarmed head. 2. Tetraphyllidea: found in sharks and rays, whilst the pupæ live in osseous fish; they have very complete hooks, and four probosces like that of *Echinorhynchus*. 3. Diphyllidea: contains the single genus *Echinobothrium*, also found in Plagiostomous fish. 4. Pseudophyllidea: with no suckers, and but few hooks, not in a circle. To this group belongs *Ligula*, common in fresh-water fish. The imago is found in water birds. *Ligula* is band-like, and unsegmented in appearance, but contains many series of reproductive organs. *Bothriocephalus* belongs here. In Russia, Poland, the Baltic, Switzerland, and Ireland, it occurs as a human parasite. Fresh-water fish have been supposed to be the means of introducing it. The larva, unlike that of any other Cestoid, is ciliated. The genital pore is in the middle of each joint of the adult worm, and the uterus is coiled. 5. Tæniada: almost exclusively as adults in the mammalia. The differences presented by the group are greatest in the pupal state; there is the *Cysticercus*, the *Cœnurus*, and the *Echniococcus* form. The common tape-worm is not *T. solium*, but *T. mediocanellata*, which has no hooks. Its hydatid or pupa harbours in the ox. A man who liked mutton seemed in spite of this discovery to be safe, but now, alas! a hydatid has been found in a mutton chop.* The *Cysticercus* form of larva is a bag, with a single small hooked head, which becomes the tape-worm head. *Cœnurus* has many of these heads, and is a much larger sac; they are found in the brain of sheep, and as the heads are hooked and retractile cause considerable cerebral disturbance. The tape-worm of the Cœnurus lives in the sheep-dog. The terrible Echinococcus, which sometimes forms cysts in the human liver, has a disputed structure. Its tape-worm is very small, and lives in the dog, having only three joints. Professor Huxley some years since had the opportunity of examining an Echniococcus cyst from the Quagga, and he now described it in some detail. The first

* Horse seems after all the only food that can be relied on.

membrane of the Echniococcus is a large elastic tunic, forming the cyst, not adventitious, but secreted by the worm (fig. 8, *c,m*).



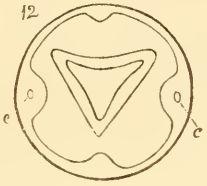
Within this is a fine cellular membrane (*v, m*), with ramifying vessels, belonging to the water-vascular system, and *said* to be ciliated. Inversions of this membrane are to be found, which are in fact Tænia heads (*h, h*). The fluid within contains granules and some calcareous matter, and also large floating and attached sacs, with *in*versions forming Tænia heads; but, strange to say, Professor Huxley found on some of the floating cysts Tænia heads growing outwards as *e*versions. Leuckhart says that these will eventually point in, but Professor Huxley agrees with Siebold, and thinks that we have here really heads growing from both surfaces of the cellular membrane. Now, in *Cœnurus* (fig. 9) we have heads all growing outwards, but in this there is no cyst membrane; and in *Echinococcus*, where there is, we may explain the inward growth of the heads by the pressure from without. This explanation of the inward growth would be very sufficient were it not for this observation of Professor Huxley's, that in the contained cysts heads grow on both surfaces. Some further explanation is required. Suppose, therefore, he says, that the cellular membrane of the cyst is folded into itself thus, as is readily admissible from analogy of Cysticercus (figs. 10, 11). Then both *a* and *b* are continuous surfaces, and the heads, after all, are produced only as processes from one and the same surface. This hypothesis depends on the observation of

heads on two opposite surfaces in the cysts of the Quagga, and Professor Huxley would like to have further confirmation of his observations.

In the Acanthocephali (*Echinorhynchi*) the head, provided with a spiny proboscis, is thrust through the wall of the intestine of its host. There is no segmentation, and no alimentary canal; the genitalia are simple, and open in a large posterior funnel. The integument exhibits an extraordinary arrangement of reticulating canals, which arise very curiously. It has lately been shown that in the ovary three shells or coverings form around the ovum. The embryo, which is directly developed, has four hooks, and is covered over with spines. Those of fresh-water fish bore their way into the legs of *Gammari*, and there lose their outer investments, and are left as mere sacs. A new blastema appears within and develops into the chief organs of the worm, and touching the wall of the sac at intervals, gives rise to the extraordinary system of reticulate vessels. They are quite different, therefore, to the vessels of the water-vascular system. It is very difficult to assign a distinct position to the Echinorhynchi.

Lecture VIII.—The group Nematoidea was held to include the Gordiacea, which in former lectures Professor Huxley has kept as a distinct group. One of the most remarkable features in Nematoides is the radial symmetry observable in a cross section. It does not seem possible in them to distinguish dorsal and ventral surface, but there is a quadruple arrangement round a centre, whilst the alimentary canal presents in section the form of an equilateral triangle. In this radial arrangement they approach the vermiform Echinoderms. The cuticle is very thick and chitinous. Its laminated layers, which cross and intercross, were till recently mistaken for muscular layers. The integument is also very largely perforated by pore canals. In these worms, too, ecdysis is a constant phenomenon. Schneider, who has recently written a great work on the group, states that twice in the life of every nematod the skin is shed. Beneath the thick cuticle is a cellular dermis, by which it is secreted. This cellular dermis gives rise to four longitudinal ridges or thickenings projecting inwards, causing those lateral lines which have been so variously interpreted by different writers. The two lateral thickenings A A are the most prominent, and contain each a vessel of the water-vascular system. They open by a pore placed near the œsophagus. Professor Huxley, in an unknown species of nematod, observed that the vessels were distinctly contractile, but no one has yet confirmed this. However that may be, there are no cilia in

these vessels, and they most certainly represent the contractile non-ciliated portion of the water-vascular system. Deeper than the dermis and its thickenings lie the muscles. Schneider has divided the Nematoidea in accordance with the arrangement of the muscular system thus: 1. Holomyaria (Gordius, Mermis). 2. Meromyaria (Trichina, &c.). 3. Polymyaria (Ascaris, Anguillula). In the first division there is a uniform, unbroken sheet of muscular tissue spread beneath the dermis; in the second division the muscular



layer is broken up into series of rhomboidal plates of muscular tissue; whilst in the third it is still more broken up, and projects in masses into the cavity of the body. These projections have been mistaken for glands by some observers. A remarkable confluence of some of the muscular fibres along the ventral line of the body, forming a sort of "raphe," has been mistaken for the gangliated cord of a nervous system. The nervous system is found in a ring surrounding the trihedral pharynx, and presenting three ganglionic enlargements. Four trunks appear to proceed from this, but two only can be traced, one along each water-vessel. The pharynx is trihedral, and presents an enlargement, which is worked by three powerful muscles, and serves as a pump. In Trichina the gullet is extremely narrow, and obscured by cellular growth; whilst in Mermis, the place of the alimentary canal is completely taken up by a mass of cells, which have received the name of corpus adiposum. The history of the development and sexual conditions of the Nematoidea is in many respects very interesting.

Lecture IX.—*Cucullanus elegans* has two hosts, a fish and a crustacean larva. *Gordius* and *Mermis* are parasitic when asexual, but free when mature. *Dracunculus*, the guinea-worm, presents a case in which there is a parasitic *propagative* state, but since no one has detected spermatozoa, the idea is suggested that they reproduce by budding, as parasites, but that, as Carter suggests, their sexual parents are free-living Nematoids of the ponds and tanks. *Sphœrularia* is another very strange case. In this there is no alimentary

canal, but large ovarian tubes; at one end grows out a small nematoid worm, said to be the male by Sir John Lubbock, who found it. At one period it is the same size as the female, as in *Diplozoon*, but the female grows enormously, while the male does not. Schneider, however, says that the supposed large female is merely a huge prolapsed ovarian sack. A third remarkable case is that of *Ascaris nigrovenosa*. In the lung of the frog they are found reproducing viviparously. The young so produced pass into the intestine, where they accumulate in the cloaca. They are very minute. When they are set free, and kept in moist earth, they become Anguillulæ, and develop into males and females. The eggs laid by these when placed in the frog's mouth pass into the lung, where they develop into the viviparous form again. No male *Ascaris nigrovenosa* (that is, the lung-infesting stage) has ever been seen, and Leuckart believes the reproduction is asexual. Schneider, however, says he saw spermatozoa in them, and he believes they are hermaphrodite. If this should prove true, the case would be one completely without parallel in the whole animal kingdom. Such an alternation of monœcious and diœcious generations is not known.

ORIGINAL COMMUNICATIONS.

On some Organisms living *at* Great Depths *in the* North Atlantic Ocean. By Professor Huxley, F.R.S.

In the year 1857, H.M.S. "Cyclops," under the command of Captain Dayman, was despatched by the Admiralty to ascertain the depth of the sea and the nature of the bottom in that part of the North Atlantic in which it was proposed to lay the telegraph cable, and which is now commonly known as the "Telegraph plateau."

The specimens of mud brought up were sent to me for examination, and a brief account of the results of my observations is given in 'Appendix A' of Captain Dayman's Report, which was published in 1858 under the title of "Deep-Sea Soundings in the North Atlantic Ocean." In this Appendix (p. 64) the following passage occurs:

"But I find in almost all these deposits a multitude of very curious rounded bodies, to all appearance consisting of several concentric layers surrounding a minute clear centre, and looking, at first sight, somewhat like single cells of the plant *Protococcus;* as these bodies, however, are rapidly and completely dissolved by dilute acids, they cannot be organic, and I will, for convenience sake, simply call them coccoliths."

In 1860, Dr. Wallich accompanied Sir Leopold McClintock in H.M.S. "Bulldog," which was employed in taking a line of soundings between the Faröe Islands, Greenland, and Labrador; and, on his return, printed, for private circulation, some "Notes on the presence of Animal Life at vast depths in the Sea." In addition to the coccoliths noted by me, Dr. Wallich discovered peculiar spheroidal bodies, which he terms "coccospheres," in the ooze of the deep-sea mud, and he throws out the suggestion that the coccoliths proceed from the coccospheres. In 1861, the same writer published a paper in the 'Annals of Natural History,' entitled "Researches on some novel Phases of Organic Life,

and on the Boring Powers of minute Annelids at great depths in the Sea." In this paper Dr. Wallich figures the coccoliths and the coccospheres, and suggests that the coccoliths are identical with certain bodies which had been observed by Mr. Sorby, F.R.S., in chalk.

The 'Annals' for September of the same year (1861) contains a very important paper by the last-named writer, "On the Organic Origin of the so-called 'Crystalloids' of the Chalk," from which I must quote several passages. Mr. Sorby thus commences his remarks:

"The appearance of Dr. Wallich's interesting paper published in this magazine (vol. viii, p. 52), in which he alludes to my having found in chalk objects similar to coccoliths, induces me to give an account of my researches on the subject. I do not claim the discovery of such bodies in the chalk, but to have been the first to point out (1) that they are not the result of crystalline action; (2) that they are identical with the objects described as coccoliths by Professor Huxley; and (3) that these are not single separate individuals, but portions of larger cells."

In respect of the statement which I have numbered (1), Mr. Sorby observes:

"By examining the fine granular matter of loose, unconsolidated chalk in water, and causing the ovoid bodies to turn round, I found that they are not flat discs, as described and figured by Ehrenberg, but, as shown in the oblique side view (fig. 5), *concave* on one side, and *convex* on the other, and indeed of precisely such a form as would result from cutting out oval watch-glasses from a moderately thick, hollow glass sphere, whose diameter was a few times greater than their own. This is a shape so entirely unlike anything due to crystalline, or any other force, acting independently of organization—so different to that of such round bodies, formed of minute radiating crystals, as can be made artificially, and do really occur in some natural deposits—and pointed so clearly to their having been derived from small hollow spheres, that I felt persuaded that such was their origin."

Mr. Sorby then states that, having received some specimens of Atlantic mud from me, he at once perceived the identity of the ovoid bodies of the chalk with the structures which I had called coccoliths, and found that, as he had predicted several years before, "the ovoid bodies were really derived from small hollow spheres, on which they occur, separated from each other at definite intervals."

The coccospheres themselves, Mr. Sorby thinks, may be

"an independent kind of organism, related to, but not the mere rudimentary form of, Foraminifera."

"With respect to the coccoliths, their optical character proves that they have an extremely fine, radiating, crystalline structure, as if they had grown by the deposition of carbonate of lime on an elongated central nucleus, in accordance with the oval-ringed structure shown in fig. 1 (magnified 800 linear)."

I am not aware that anything has been added to our knowledge of the "coccoliths" and "coccospheres" since the publication of Mr. Sorby's and Dr. Wallich's researches. Quite recently I have had occasion to re-examine specimens of Atlantic mud, which were placed in spirits in 1857, and have since remained in my possession. I have employed higher magnifying powers than I formerly worked with, or than subsequent observers seem to have used, my great help having been an excellent $\frac{1}{10}$th by Ross, which easily gives a magnifying power of 1200 diameters, and renders obvious many details hardly decipherable with the $\frac{1}{5}$th inch objective which I used in 1857.

The sticky or viscid character of the fresh mud from the bottom of the Atlantic is noted by Captain Dayman.* "Between the 15th and 45th degrees of west longitude lies the deepest part of the ocean, the bottom of which is almost wholly composed of the same kind of soft, mealy substance, which, for want of a better name, I have called ooze. This substance is remarkably sticky, having been found to adhere to the sounding rod and line (as has been stated above) through its passage from the bottom to the surface—in some instances from a depth of more than 2000 fathoms."

This stickiness of the deep-sea mud arises, I suppose, from the circumstance that, in addition to the *Globigerinæ* of all sizes which are its chief constituents, it contains innumerable lumps of a transparent, gelatinous substance. These lumps are of all sizes, from patches visible with the naked eye to excessively minute particles. When one of these is submitted to microscopical analysis it exhibits—imbedded in a transparent, colourless, and structureless matrix—granules, coccoliths, and foreign bodies.

The *granules* vary in size from $\frac{1}{40000}$th of an inch to $\frac{1}{8000}$th, and are aggregated together into heaps of various sizes and shapes (Pl. IV, fig. 1), some having the form of mere irregular streaks, but others possessing a more definitely limited

* Loc. cit., p. 9.

oval or rounded figure (fig. 1 *c*). Some of the heaps attain $\frac{1}{1000}$th of an inch or more in diameter, while others have not more than a third or a fourth of that size. The smallest granules are rounded; of the larger, many are biconcave oval discs, others are rod-like,* the largest are irregular.

Solution of iodine stains the granules yellow, while it does not affect the matrix. Dilute acetic acid rapidly dissolves all but the finest and some of the coarsest granules, but apparently has no effect on the matrix. Moderately strong solution of caustic soda causes the matrix to swell up. The granules are little affected by weak alkalies, but are dissolved by strong solutions of caustic soda or potash.

I have been unable to discover any nucleus in the midst of the heaps of granules, and they exhibit no trace of a membranous envelope. It occasionally happens that a granule-heap contains nothing but granules (fig. 1 *a*), but, in the majority of cases, more or fewer coccoliths lie upon, or in the midst of, the granules. In the latter case the coccoliths are almost always small and incompletely developed (fig. 1 *b*, *c*).

The *coccoliths* are exceedingly singular bodies. My own account of them, quoted above, is extremely imperfect, and in some respects erroneous. And though Mr. Sorby's description is a great improvement on mine, it leaves much to be said.

I find that two distinct kinds of bodies have been described by myself and others under the name of coccoliths. I shall term one kind *Discolithus*, and the other *Cyatholithus*.

The *Discolithi* (fig. 2) are oval discoidal bodies, with a thick, strongly refracting rim, and a thinner central portion, the greater part of which is occupied by a slightly opaque, as it were, cloud-like patch. The contour of this patch corresponds with that of the inner edge of the rim, from which it is separated by a transparent zone. In general, the discoliths are slightly convex on one side, slightly concave on the other, and the rim is raised into a prominent ridge on the more convex side, so that an edge view exhibits the appearance shown in fig. 2 *d*.

The commonest size of these bodies is between $\frac{1}{4000}$th and $\frac{1}{5000}$th of an inch in long diameter; but they may be found, on the one hand, rising to $\frac{1}{2700}$th of an inch in length, (fig. 2 *f*), and, on the other, sinking to $\frac{1}{11000}$th (fig. 2 *a*). The last mentioned are hardly distinguishable from some of

* These apparent rods are not merely edge views of disks.

the granules of the granule-heaps. The largest discoliths are commonly free, but the smaller and smallest are very generally found imbedded among the granules.

The second kind of coccolith (fig. 4 *a*—*m*), when full grown, has an oval contour, convex upon one face, and flat or concave upon the other. Left to themselves, they lie upon one or other of these faces, and in that aspect appear to be composed of two concentric zones (fig. 4 *d*, 2, 3) surrounding a central corpuscle (fig. 4 *d*, 1). The central corpuscle is oval, and has thick walls; in its centre is a clear and transparent space. Immediately surrounding this corpuscle is a broad zone (2), which often appears more or less distinctly granulated, and sometimes has an almost moniliform margin. Beyond this appears a narrower zone (3), which is generally clear, transparent, and structureless, but sometimes exhibits well-marked striæ, which follow the direction of radii from the centre. Strong pressure occasionally causes this zone to break up into fragments bounded by radial lines.

Sometimes, as Dr. Wallich has already observed, the clear space is divided into two (fig. 1 *e*). This appears to occur only in the largest of these bodies, but I have never observed any further subdivision of the clear centre, nor any tendency to divide on the part of the body itself.

A lateral view of any of these bodies (fig. 4 *f*—*i*) shows that it is by no means the concentrically laminated concretion it at first appears to be, but that it has a very singular and, so far as I know, unique structure. Supposing it to rest upon its convex surface, it consists of a lower plate, shaped like a deep saucer or watch-glass; of an upper plate, which is sometimes flat, sometimes more or less watch-glass-shaped; of the oval, thick-walled, flattened corpuscle, which connects the centres of these two plates; and of an intermediate substance, which is closely connected with the under surface of the upper plate, or more or less fills up the interval between the two plates, and often has a coarsely granular margin. The upper plate always has a less diameter than the lower, and is not wider than the intermediate substance. It is this last which gives rise to the broad granular zone in the face view.

Suppose a couple of watch-glasses, one rather smaller and much flatter than the other; turn the convex side of the former to the concave side of the latter, interpose between the centre of the two a hollow spheroid of wax, and press them together —these will represent the upper and lower plates and the central corpuscle. Then pour some plaster of Paris into the interval left between the watch-glasses, and that will take the

place of the intermediate substance. I do not wish to imply, however, that the intermediate substance is something totally distinct from the upper and lower plates. One would naturally expect to find protoplasm between the two plates; and the granular aspect which the intermediate substance frequently possesses is such as a layer of protoplasm might assume. But I have not been able to satisfy myself completely of the presence of a layer of this kind, or to make sure that the intermediate substance has other than an optical existence.

From their double-cup shape I propose to call the coccoliths of this form *Cyatholithi*. They are stained, but not very strongly, by iodine, which chiefly affects the intermediate substance. Strong acids dissolve them at once, and leave no trace behind; but by very weak acetic acid the calcareous matter which they contain is gradually dissolved, the central corpuscle rapidly loses its strongly refracting character, and nothing remains but an extremely delicate, finely granulated, membranous framework of the same size as the cyatholith.

Alkalies, even tolerably strong solution of caustic soda, affect these bodies but slowly. If very strong solutions of caustic soda or potash are employed, especially if aided by heat, the cyatholiths, like the discoliths, are completely destroyed, their carbonate of lime being dissolved out, and afterwards deposited usually in hexagonal plates, but sometimes in globules and dumb-bells.

The *Cyatholithi* are traceable from the full size just described, the largest of which are about $\frac{1}{1600}$th of an inch long, down to a diameter of $\frac{1}{8000}$th of an inch. Their structure remains substantially the same, but those of $\frac{1}{3000}$th of an inch in diameter and below it are always circular instead of oval; the central corpuscle, instead of being oval, is circular, and the granular zone becomes very delicate. In the smallest the upper plate is a flat disc, and the lower is but very slightly convex (fig. 1 *f*). I am not sure that in these very small cyatholiths any intermediate substance exists, apart from the under or inner surface of the upper disc. When their flat sides are turned to the eye, these young cyatholiths are extraordinarily like nucleated cells; and it is only by carefully studying side views, when the small cyatholiths remind one of minute shirt-studs, that one acquires an insight into their real nature. The central corpuscles in these smallest cyatholiths are often less than $\frac{1}{20000}$th of an inch in diameter, and are not distinguishable optically from some of the granules of the granule-heaps.

The *coccospheres* occur very sparingly in proportion to the coccoliths. At a rough guess, I should say that there is not

one of the former to several thousand of the latter. And owing to their rarity, and to the impossibility of separating them from the other components of the Atlantic mud, it is very difficult to subject them to a thorough examination.

The coccospheres are of two types—the one compact, and the other loose in texture. The largest of the former type which I have met with measured about $\frac{1}{1300}$th of an inch in diameter (fig. 6 *e*). They are hollow, irregularly flattened spheroids, with a thick transparent wall, which sometimes appears laminated. In this wall a number of oval bodies (1), very much like the "corpuscles" of the cyatholiths, are set, and each of these answers to one of the flattened facets of the spheroidal wall. The corpuscles, which are about $\frac{1}{4500}$th of an inch long, are placed at tolerably equal distances, and each is surrounded by a contour line of corresponding form. The contour lines surrounding adjacent corpuscles meet and overlap more or less, sometimes appearing more or less polygonal. Between the contour line and the margin of the corpuscle the wall of the spheroid is clear and transparent. There is no trace of anything answering to the granular zone of the cyatholiths.

Coccospheres of the compact type of $\frac{1}{1700}$th to $\frac{1}{2000}$th of an inch in diameter occur under two forms, being sometimes mere reductions of that just described, while, in other cases (fig. 6, *c*), the corpuscles are round, and not more than half to a third as big ($\frac{1}{11000}$th of an inch), though their number does not seem to be greater. In still smaller coccospheres (fig. 6 *a*, *b*) the corpuscles and the contour lines become less and less distinct and more minute until, in the smallest which I have observed, and which is only $\frac{1}{4500}$th of an inch in diameter (fig. 6 *a*) they are hardly visible.

The coccospheres of the loose type of structure run from the same minuteness (fig. 7 *a*) up to nearly double the size of the largest of the compact type, viz. $\frac{1}{700}$th of an inch in diameter. The largest, of which I have only seen one specimen (fig. 7, *d*), is obviously made up of bodies resembling cyatholiths of the largest size in all particulars, except the absence of the granular zone, of which there is no trace. I could not clearly ascertain how they were held together, but a slight pressure sufficed to separate them.

The smaller ones (fig. 7 *b*, *c*, and *a*) are very similar to those of the compact type represented in figs. 6, *c* and *d*; but they are obviously, in the case of *b* and *c*, made up of bodies resembling cyatholiths (in all but the absence of the granular zone), aggregated by their flat faces round a common

centre, and more or less closely coherent. In *a*, only the corpuscles can be distinctly made out.

Such, so far as I have been able to determine them, then, are the facts of structure to be observed in the gelatinous matter of the Atlantic mud, and in the coccoliths and coccospheres. I have hitherto said nothing about their meaning, as in an inquiry so difficult and fraught with interest as this, it seems to me to be in the highest degree important to keep the questions of fact and the questions of interpretation well apart.

I conceive that the granule-heaps and the transparent gelatinous matter in which they are imbedded represent masses of protoplasm. Take away the cysts which characterise the *Radiolaria*, and a dead *Sphærozoum* would very nearly resemble one of the masses of this deep-sea "Urschleim," which must, I think, be regarded as a new form of those simple animated beings which have recently been so well described by Haeckel in his 'Monographie der Moneren.'* I proposed to confer upon this new "Moner" the generic name of *Bathybius*, and to call it after the eminent Professor of Zoology in the University of Jena, *B. Haeckelii*.

From the manner in which the youngest *Discolithi* and *Cyatholithi* are found imbedded among the granules; from the resemblance of the youngest forms of the *Discolithi* and the smallest "corpuscles" of *Cyatholithus* to the granules; and from the absence of any evident means of maintaining an independent existence in either, I am led to believe that they are not independent organisms, but that they stand in the same relation to the protoplasm of *Bathybius* as the spicula of Sponges or of *Radiolaria* do to the soft part of those animals.

That the coccospheres are in some way or other closely connected with the cyatholiths seems very probable. Mr. Sorby's view is that the cyatholiths result from the breaking up of the coccospheres. If this were the case, however, I cannot but think that the coccospheres ought to be far more numerous than they really are.

The converse view, that the coccospheres are formed by the coalescence of the cyatholiths, seems to me to be quite as probable. If this be the case, the more compact variety of the coccospheres must be regarded as a more advanced stage of development of the loose form.

On either view it must not be forgotten that the components of the coccospheres are not identical with the free cyatholiths; but that, on the supposition of coalescence, the disappearance of the granular layer has to be accounted for;

* 'Jenaische Zeitschrift,' Bd. iv, Heft 1.

while, on the supposition that the coccospheres dehisce, it must be supposed that the granular layer appears after dehiscence; and, on both hypotheses, the fact that both coccospheres and cyatholiths are found of very various sizes proves that the assumed coalescence or dehiscence must take place at all periods of development, and is not to be regarded as the final developmental act of either coccosphere or cyatholith.

And, finally, there is a third possibility—that the differences between the components of the coccospheres and the cyatholiths are permanent, and that the coccospheres are from the first independent structures, comparable to the wheel-like spicula associated in the wall of the "seeds" of *Spongilla*, and perhaps enclosing a mass of protoplasm destined for reproductive purposes.

In addition to *Bathybius* and its associated discoliths, cyatholiths, and coccospheres, the Atlantic mud contains—

a. Masses of protoplasm surrounded by a thick but incomplete cyst, apparently of a membranous or but little calcified consistence, and resembling minute *Gromiæ*. It is possible that these are unfinished single chambers of *Globigerinæ*.

b. *Globigerinæ* of all sizes and ages, from a single chamber $\frac{1}{1500}$th of an inch in diameter, upwards. I may mention incidentally that very careful examination of the walls of the youngest forms of *Globigerina* with the $\frac{1}{12}$th leads me to withdraw the doubt I formerly expressed as to their perforation.

In the absence of any apparent reproductive process in *Globigerinæ*, is it possible that these may simply be, as it were, offsets, provided with a shell, of some such simple form of life as *Bathybius*, which multiplies only in its naked form?

c. Masses of protoplasm enclosed in a thin membrane.

d. A very few *Foraminifera* of other genera than *Globigerina*.

e. *Radiolaria* in considerable numbers.

f. Numerous *Coscinodisci* and a few other Diatoms.

g. Numerous very minute fragments of inorganic matter.

The *Radiolaria* and Diatoms are unquestionably derived from the surface of the sea; and in speculating upon the conditions of existence of *Bathybius* and *Globigerina*, these sources of supply must not be overlooked.

With the more complete view of the structure of the cyatholiths and discoliths which I had obtained, I turned to

the chalk, and I am glad to have been enabled to verify Mr. Sorby's statements in every particular. The chalk contains cyatholiths and discoliths identical with those of the Atlantic soundings, except that they have a more dense look and coarser contours (figs. 3 and 5). In fact, I suspect that they are fossilized, and are more completely impregnated with carbonate of lime than the recent coccoliths.

I have once met with a coccosphere in the chalk; and, on the other hand, in one specimen of the Atlantic soundings I met with a disc with a central cross, just like the body from the chalk figured by Mr. Sorby (fig. 8).

Notes *on some* Rare British Polyzoa, *with* Descriptions *of* New Species. By the Rev. Alfred Merle Norman, M.A.

The object of the following paper is to embrace a few notes upon some of the rarer of the British Polyzoa, and to describe several species new to science.

Brettia pellucida, *Dyster.*

Brettia pellucida, Dyster. Quart. Jour. Mic. Sc., N. S., vol. vi (1858), p. 260, pl. xxi, figs. 3—5.

This species is omitted in the 'Catalogue of the British Marine Invertebrate Fauna' published by the British Association. The type specimens were found at Tenby. In 1865 I procured some small fragments when dredging with my friend Mr. Jeffreys in the Minch.

Brettia pellucida seems to be congeneric with *Alysidium Lafontii,* Busk; but that species can hardly belong to the same genus as *Alysidium parasiticum,* Busk. I would propose, therefore, to leave the latter as the type of the genus Alysidium, and to remove *A. Lafontii* to the genus Brettia.

Scruparia clavata, *Hincks.*

Scruparia clavata, Hincks. Quart. Jour. Mic. Sci., N. S., vol. v (1857), p. 175, pl. xvii, figs. 5—8.

Huxleya fragilis, Dyster. Quart. Jour. Mic. Sci., N. S., vol. vi (1858), p. 260, pl. xxi, figs. 1, 2.

There cannot be, I think, any doubt as to the identity of

Dyster's genus Huxleya with the *Scruparia clavata* of Hincks, published in the preceding volume of the 'Microscopical Journal.'

Hab. Filey and Lamlash Bay (Hincks). Tenby (Dyster).

Cellularia Peachii, *Busk.*

Cellularia Peachii, Busk. Ann. Nat. Hist., N. S., vol. vii, p. 82, pl. viii, figs. 1—4; Cat. Marine Polyzoa, p. 20, pl. xxvii, figs. 3—5; Smitt, Öfversigt af K. Vet. Akad. Förhand., 1867, p. 285, pl. xvii, figs. 51—53.

Mr. Busk gives no further locality for this species than "*Hab.* Britain (North?)." I have dredged it off the Northumberland coast and Shetland, and have received it from Scarborough (Bean) and Aberdeenshire (Dawson). Smitt records it from Bahusia and Spitzbergen.

Menipea Jeffreysii, n. sp. Pl. V, figs. 3—5.

Polyzoary dichotomously branched. *Cells* 4—7, at an internode, elongated below; apertures regularly oval, margin a little raised, above three (or four) spines; on the outer angle of each cell is a small process, probably the base of a larger spine, which has been broken off; a small avicularium in front of each cell beneath the mouth; mouth furnished with an operculum, which is *entire*. *Ovicell* erect, smooth.

A minute portion of this species was found by Mr. Peach among sand dredged in Shetland in 1864, and two other still more microscopic fragments were found by him in sand dredged by Mr. Jeffreys and myself in Shetland in 1865. These fragments are amply sufficient to show that we have a new species in them, but not sufficient to enable the characters to be accurately defined. In every cell except one the operculum is broken off; that one Mr. Alder has, in the figure he kindly drew for me, represented as lobed, but the operculum was dirty at the time, and having since cleansed it, I find it to be entire, and that what appeared to be divisions were surface markings only.

At Mr. Peach's request, I have dedicated the species to my friend Mr. Jeffreys, with whom I have spent so many a happy hour in examining the Fauna of our seas.

This species approaches, in its general characters, to the Arctic Menipea which is figured by Smitt, in his recently published papers on Scandinavian Polyzoa, as *Cellularia*

ternata, forma duplex, but differs from it in the presence of the oral spines and operculum, and the absence of well-marked lateral avicularia. As I cannot regard the form figured by Smitt as a variety of *M. ternata,* and it seems desirable to point out the distinguishing characters which separate it from its allies, I draw up the following description from the figures referred to, and name the form after its discoverer.

Menipea Smittii, n. sp. (*not British*).

Menipea ternata, γ, forma duplex, Smitt. Öfversigt af K. Vet. Akad. Förhan., 1867, p. 283, pl. xvi, figs. 25, 26.

Cells in a double row, as many as twelve to an internode, elongated; oral aperture ovate, not furnished with spines or operculum. A lateral avicularium of moderate size, and also a small suboral avicularium in front of each cell.

Found by Malmgren in 50 fathoms, at Spitzbergen, in 1861.

Scrupocellaria scrupea, *Busk.*

Scrupocellaria scrupea, Busk. Cat. Marine Polyzoa, p. 24, pl. xxi, figs. 1, 2.

— — Heller. Die Bryozoën des Adriatischen Meeres (1867), p. 10.

Guernsey and the Minch (A. M. N.). Adriatic Sea (Grube and Heller).

The ovicells in this species, which had not apparently been seen by Busk, are imperforate; and in this respect the species differs from the *Crisia pilosa,* Audouin (Savigny, 'Egypt,' pl. xii, fig. 1), to which, in its other characters, it is closely allied.

Scrupocellaria scabra, *Van Ben.*

Sertularia halecina, Fabric. Faun Groenl., p. 443 (fide Smitt).

Flustra scruposa, Fab. Nye Zool. Bidr. in Vid. Selsk. Phys. Skr., 1821, p. 33 (fide Smitt).

Cellarina scabra, V. Beneden. Bull. Brux., vol. xv, p. 73, figs. 3—6.

Cellularia scrupea, Alder. Trans. Tyneside Nat. Field Club, vol. iii, p. 148.

Scrupocellaria scruposa, Busk. Quart. Journ. Mic. Sci., vol. iii, p. 254.

Scrupocellaria Delilii, Busk. Jour. Mic. Soc., vol. vii, p. 65, pl. xxii, figs. 1—3 (but not *C. Delilii* of Audouin).

— — Alder. Quart. Jour. Mic. Sci., N. S., vol. iv (1864), pl. iii, figs. 4—8; Nat. Hist. Trans. Northumberland and Durham, vol. i, p. 163, pl. viii, figs. 4—8.

Cellularia scabra, Smitt. Öfversigt af K. Vet. Akad. Förh., 1867, p. 283, pls. xxvii—xxxiv.

The species described by Busk and Alder is most certainly not the *Crisia Delilii* of Audouin (Savigny, 'Egypt,' pl. xii, fig. 3), which is characterised by an unusually developed lateral avicularium, and an erect vibracular capsule, while in the Madeira and British species the avicularium is not larger than usual in the genus, and the vibracular capsule is large and *placed transversely*. Mr. Alder had not seen Savigny's figure, and ascribed his specimens to *S. Delilii*, fide Busk.

SCRUPOCELLARIA INERMIS, *Norman*. Pl. V, figs. 1—3.

Scrupocellaria inermis, Norman. Report of the British Association, 1866 (1867). Report, p. 203.

Polyzoary rather stout, yellowish horn-coloured, dichotomously branched. *Cells* oblong; apertures elliptical, having a broad flattened margin without spines or operculum. *Marginal avicularia* not prominent; no central avicularium. *Vibracular capsules* subtriangular, scarcely so broad as high, with the open margin, stretching diagonally downwards and inwards; vibracula short. *Oricells* smooth and imperforate, set at a slight angle inclining inwards. Height about half an inch.

One or two small specimens of this Scrupocellaria were dredged by Mr. Jeffreys and myself in Shetland in 1863, and it was again found in the following year by Mr. Peach. In 1866 I met with a small specimen when dredging in the Minch. Its characters come very near to those of *S. scruposa*, but it differs in its more robust form, in the broad flattened margin of the apertures, and in the absence of spines; the marginal avicularia are less prominent, and the vibracular capsules are broad and triangular, with the open margin extending diagonally downwards. This last is, perhaps, the best character to distinguish the two species, as the

vibracular capsules of *S. scruposa* are narrow and erect, with the opening extending perpendicularly downwards.

Hippothoa expansa, n. sp. Pl. VI, figs. 1, 2.

Polyzoary adherent, branched, spreading, calcareous and semitransparent. *Cells* oblong-ovate, ribbed transversely, and very minutely striated longitudinally, tapering below into a tubular stem; aperture terminal at the upper end, rather small and rounded, with a sinus below, the rim thin and a little elevated. The cells and connecting tubes are bordered by a thin calcareous expansion, through which the tubes run, those of each branch arising from the side of a cell at a very slight angle, the branches occasionally anastomosing. Length of cells about one twentieth of an inch, expansion of polyzoary from a quarter to half an inch.

Dredged in 100 fathoms off Unst, Shetland, in 1864, by Messrs. Jeffreys and Peach.

The specimen from which this description is taken is upon an old shell of *Pecten Islandicus*, a species which has not been found recent on our coast. There are also adhering to the same shell a Spirorbis and a *Lepralia* (*ventricosa*), which are common in the same seas at the present time, and an unknown Cellepora, apparently subfossil. The Hippothoa, however, is quite fresh, preserving a gloss and transparency which leave little doubt of its being a recent species. This, the only known specimen, is now, with the rest of the collection of the late Mr. Alder, in the Museum at Newcastle-upon-Tyne.

Ætea sica, *Couch*.

Hippothoa sica, Couch. Corn. Fauna, iii, p. 102, pl. xix, fig. 8; Johnston, British Zoophytes, 2nd edition, p. 292.

Ætea recta, Hincks. Catalogue of Zoophytes Devon and Cornwall, p. 35, pl. vii, fig. 3.

— *anguina*, β, *forma recta*, Smitt. Öfversigt af K. Vet. Akad. Förh., p. 281, pl. xvi, figs. 5, 6.

This species is probably distributed all round our coasts, as I have procured it from the following localities:—Guernsey, Cornwall, Antrim, West of Scotland, and Shetland. Smitt finds it in Scandinavia.

Caberea Boryi, *Audouin.*

Crisia Boryi, Audouin. Explic. Savigny, Egypt, pl. xii, fig. 4.
Cellularia Hookeri, Fleming. Brit. Animals, p. 539 (not *C. Hookeri*, Johnston).
Caberea Boryi (plates named *C. zelanica* and *C. patagonica*), Busk. Cat. Marine Polyzoa, p. 38, pl. xvi, figs. 4, 5, and pl. xxxviii.
— — Heller. Die Bryozoën des Adriatischen Meeres, p. 13.

This species is essentially a southern form. It is common in Guernsey, and I have also found it in Jersey. On the English coast I believe it has only been met with at Torquay (Hooker) and Budleigh-Salterton (Hincks). It was originally described from the coast of Egypt, and Heller finds it in the Adriatic. Busk gives the following localities:—Cumberland Island; New Zealand; E. Falkland; S. Patagonia, 49° S.; Port St. Julian, Patagonia; Strait of Magellan; Algoa Bay. If these habitats be all correct, the range of this species is most extraordinary. No other Polyzoa—probably *very* few marine animals—have so extensive a distribution. *L. Boryi* may at once be distinguished from the next species by the presence of its oral opercula.

Caberea Ellisii, *Fleming.*

Flustra Ellisii, Fleming. Mem. Wernerian Soc., vol. ii, p. 251, pl. xvii, fig. 1.
— *setacea*, Fleming. British Animals, p. 536.
Cellularia Hookeri, Johnston. Brit. Zoophytes, 2nd edit., p. 338, pl. lx, figs. 1—2 (but not *C. Hookeri*, Fleming).
Caberea — Busk. Cat. Marine Polyzoa, p. 39, pl. xxxvii, fig. 2.
— *Ellisii*, Hincks. Cat. Zoophytes Devon and Cornwall, p. 63; Smitt, Öfversigt af K. Vet. Akad. Förhand., 1867, p. 287, pl. xvii, figs. 55, 56.

This I find to be one of the more common Polyzoa in the Shetland seas. I have also dredged it in the Minch, the most southern habitat in which the species has as yet been found. Coasts of Scandinavia and Finmark (Smitt).

Bicellaria Alderi, *Busk.*

Bicellaria Alderi, Busk. Quart. Journ. Mic. Sci., 1860, p. 143, pl. xxviii, figs. 1—3; Smitt, Öfversigt af K. Vet. Akad. Förh., 1867, p. 289, pl. xviii, figs. 4—8.

— *unispinosa*, M. Sars. Geol. Zool. og Jagttagelser anstellede paa en Reise i en Deel af Trondhjens Stift, 1863, p. 34.

The ovicells in this species remind one, in their form, of the flower of the calceolaria, to the form of which they bear a close resemblance. They lean backwards, are imperforate, polished, sculptured with fine raised lines radiating in a fan-like form from the centre of the lower margin, and terminating at a circular, similarly raised line, which girdles the ovicell near its summit.

The only spot in Shetland in which I have dredged this interesting Bicellaria is 5—7 miles east of the Island of Balta, in 40—50 fathoms. The ground is soft; the dredge comes up choked with thousands of *Ascidia sordida*, great quantities of *Tubularia gracilis*, *Halecium halecinum*, &c., and attached to these Hydrozoa is found the Bicellaria. Since the species was described by Mr. Busk from Mr. Barlee's specimens it has been found by Professor Sars in Norway, and described under the name above quoted.

Bugula calathus, n. sp. Pl. VI, figs. 3—8.

Polyzoary consisting of a number of strap-formed, dichotomously dividing branches, spreading regularly round on all sides from the base, and forming an elegantly shaped shallow cup, all the straps generally of about equal length; drying of a yellowish horn colour. *Cells* in about 6—8 rows, oblong above, with two stout, blunt spines at each angle. *Ovicells* globular, large, imperforate, smooth, polished, with a raised, thread-like, transverse line near their base. Lateral avicularia large; smaller avicularia here and there on the margins of the inner cells. Height of a large specimen three fifths of an inch, diameter one inch and a quarter.

Under stones between tidemarks, Herm.

This species comes very near to *B. flabellata*, and much more so in its microscopical than in its general characters. Instead of being convoluted, as is generally more or less the case with *B. flabellata*, it always takes the form of an elegant simple cup, and the breadth is much greater in proportion to the height than in the allied species. *B. flabellata* turns

to an ashy colour in drying, but *B. calathus* preserves the yellowish horn-coloured hue which it has in life. The ovicells are proportionately somewhat larger, the lateral avicularia much larger, and the spines shorter and blunter than in *B. flabellata*, of which a figure (fig. 9) is given for comparison.

My late friend Mr. Alder agreed with me in considering the species here described to be distinct from *B. flabellata*; and for the accurate illustrations of this and the other species here described, except the Hemescharæ, I am indebted to him as among the last of many kindnesses. Some of the figures were among the last drawings that he made before he was seized with the fatal illness which deprived us of the most able and the most accurate of British marine zoologists.

Bugula purpurotincta.

Bugula fastigiata, Alder. Cat. Zoophytes Northumberland and Durham, p. 59.

Cellularia plumosa, Johnston. Brit. Zooph., 2nd edit., p. 341, pl. lxi (*but not of Busk*).

This Bugula seems generally to take the place of *B. plumosa* in the north, but both species are found on the coast of Durham. I have dredged it at Shetland and on the Northumberland coast, and have received it from Scaham, county Durham (Mr. Hodge), and Scarborough (Mr. Bean). The beautiful purplish-red tint it assumes when preserved will enable it at once to be distinguished without any microscopical examination from *B. plumosa;* it is also a much larger and stronger species. Norway (Sars).

Mr. Alder referred this Bugula, which he well described, to the *Sertularia fastigiata* of O. Fabricius; but Smitt has pointed out ('Öfversigt af K. Vet. Akad. Förh.,' 1867, p. 291) that Fabricius, in a subsequent paper ('Nye Zool. Bidr., in Vid. Selsk. Skr.' (Havniæ), vol. i, 1821, p. 35), stated that the *S. fastigiata* of his 'Fauna Groenlandica' was synonymous with *Sertularia argentea;* and, judging from the synonyms given by Linnæus, it would seem that the *Sertularia fastigiata* of the 'Syst. Nat.' is our *B. plumosa* rather than the present species, which it becomes necessary, therefore, to name.

Bugula turbinata, *Alder*.

Bugula turbinata, Alder. Mic. Journ., vol. v, p. 174, pl. xvii.

This pretty species appears to be much more common and

generally diffused than *B. avicularia*, with which it was formerly confounded. Specimens from under the granite rocks at Herm are most beautifully developed.

Flustra Barleii, *Busk*.

Flustra Barleii, Busk. Quart. Jour. Mic. Sci., vol. viii (1860), p. 123, pl. xxv, fig. 4.

— *membranaceo-truncata*, Smitt. Öfversigt af K. Vet. Akad. Förh. (1860), p. 358, pl. xx, figs. 1—5.

The *polyzoary* in this species is very thin and remarkably brittle. The species is very scarce in Shetland. Much as I have dredged there, I have only met with a few fragments in about fifty fathoms off Unst, and the original examples procured by Mr. Barlee still remain the only good ones in my collection. It has very recently been described by Smitt from Arctic specimens.

Eschara rosacea, *Busk*. Pl. VI, figs. 10—12.

Eschara rosacea, Busk. Ann. Nat. Hist., 2nd ser., vol. xviii, p. 33, pl. i, fig. 4.

Escharoides rosacea, Smitt. Öfversigt af K. Vet. Akad. Förhand. (1867), Bihang, p. 25, pl. xxvi, figs. 155—159.

Polyzoary consisting of flat, subpalmate, foliaceous lobes, composed of two layers of cells placed back to back; the lobes variously curved, and not in the same plane. *Cells* elongated ovate, granulated, only slightly convex, quincuncially arranged; mouth sunken, well arched above, with a sinus on the lower lip, and an avicularium, which has a lateral direction, appearing on one side of the sinus; mandible semicircular. *Ovicell* semiglobose, granulated.

Loch Fyne, on small stones and old shells of *Pecten opercularis*, now first added to the British Fauna. Known previously on the coast of Norway, where it has been procured by McAndrew; Finmark (Lovén); Spitzbergen (Malmgren).

The size of a large British specimen is three quarters of an inch broad, and not quite as high. Figs. 10 and 11 are drawn from a British specimen; fig. 12 is added to show the ovicells, and is taken from a Norwegian typical example sent to Mr. Alder by Mr. Busk.

According to Smitt, the *Eschara rosacea* of Sars is not Busk's species, being distinguished from it by having the mandible of the avicularium triangular, and he has named it *Escharoides Sarsii*.

ESCHARA QUINCUNCIALIS, *Norman*. Pl. VII, figs. 1—3.

Eschara quincuncialis. Rep. of the Brit. Assoc. 1866 (1867). Report, p. 204.

Polyzoary white, smooth, polished, cylindrical. *Cells* distant in linear series, regularly arranged in quincunx round an imaginary axis, swollen, mammæform; mouth key-hole shaped, rounded above, with a small sinus below, and a small inconspicuous avicularium on the margin. *Ovicell* small, with 1—4 round perforations.

The type specimen is apparently a mere fragment, and is not more than a quarter of an inch long. It is, however, clearly distinct from all the allied species with which we are acquainted. It was dredged by Mr. Jeffreys and myself in 1866 in deep water in the Minch.

HEMESCHARA STRUMA, n. sp. Pl. VII, figs. 6—8.

Polyzoary sometimes encrusting stones, at others creeping over *Porella cervicornis*, and stretching from branch to branch of that coral, in both cases rising here and there into free frill-like expansions; yellowish, glistening. *Cells* immersed, quincuncially arranged, obovate; throat greatly swollen (goitre-like), surface channelled with irregular depressions, which, however, round the edge assume the form of wedge-shaped foveolæ; a rounded avicularium just within the lower lip; mouth broader than high, upper and lower lips simple, well arched, meeting at a point at the sides. *Ovicell* semicircular, not much raised (about equal in elevation to the goitre-formed throat), surface uneven, not punctate.

The more mature cells are seen to be separated from each other by a raised line, and the marginal foveolæ become much more distinct. The figures are taken from young cells.

The cells of this species are, in their general character, very like those of *L. concinna;* they are, however, considerably larger than in that species, and the surface is channelled with foveolæ, instead of being rough and granulated; the mouth is also of different form, and broader than long, instead of the reverse.

Dredged in 100 fathoms about twenty-five miles north of the Island of Unst, the most northern of the Shetland group. It is very rare, and the specimens obtained are small, the free expansions not exceeding half an inch high, and consisting of a single series of cells.

HEMESCHARA SANGUINEA, n. sp. Pl. VII, figs. 9—11.

Polyzoary spreading in a film-like, semi-attached state over shells, and sometimes rising in frill-formed, free expansions, consisting of a single series of cells; colour deep red, shining. *Cells* subquadrangular, distributed in nearly straight subparallel lines, and quincuncially arranged, flattened, perforated; perforations large, circular; mouth well arched above, having a central sinus on the lower lip, on each side of which is a little notch cut in sideways (see fig. 11); no oral avicularia. *Ovicells* semiglobose, tumid, perforated, surface between the perforations raised into nodulous processes.

H. sanguinea differs from the other species here included in the genus in not having any oral avicularium. Several specimens were dredged off Fermain Bay, Guernsey, based on shells (*Pecten maximus, Pectunculus glycymeris*, &c.), and one on *Eschara foliacea*.

I suspect that Busk's figures, pl. lxxviii, figs. 1 and 2, are drawn from this species. They are called *Lepralia pertusa*; but in *L. pertusa* the cells are ovate and very tumid, the mouth without any sinus on the lower lip. That species is well figured (Busk, pl. lxxviii, fig. 3; and pl. lxxix, figs. 1 and 2).

CELLEPORELLA LEPRALIOIDES, n. sp. Pl., VII, figs. 4, 5.

Polyzoary small, encrusting, in little lobed patches on small stones. *Cells* irregularly disposed, cylindrical, elongated, semi-erect, upper portion free (except in marginal cells), surface rugose; mouth nearly circular, apical, opening upwards; peristome much raised, no avicularia. There are large scattered punctures here and there upon the sides of the cells, but they are not always very easily seen.

Hab. Shetland, in 90 to 110 fathoms, living on small pebbles. This is another addition to the large assemblage of Polyzoa which live in the deep waters of the Shetland seas, and have not been found elsewhere off our coasts.

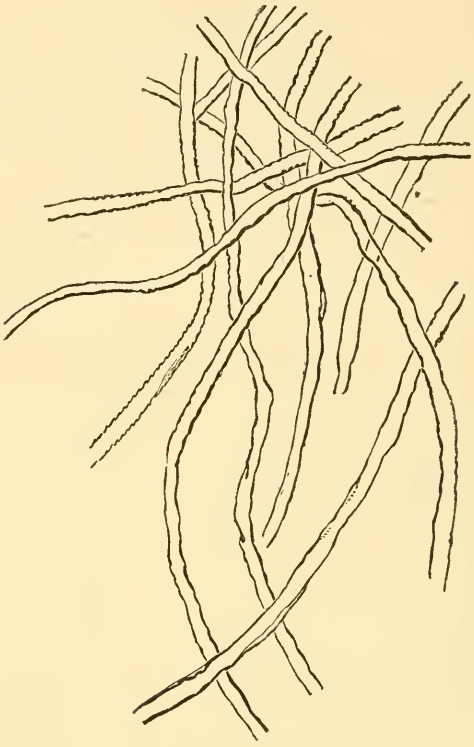
On the "Muffa" *of the* Sulphur Springs *at* Valdieri.

By J. Moggridge, F.G.S., Richmond.

The baths of Valdieri, not far from a Piedmontese town of that name, are situated in a valley on the northern side of the Maritime Alps, and have long been celebrated, not only for the coolness of their climate and the excellence of their mineral waters, but also for the "Muffa," a substance occurring in one of those waters, which, while of great medicinal value as an external application, is interesting, when viewed under the microscope, for the vegetable, animal, and mineral productions which it contains. These baths are 4426 feet above the level of the sea. Found in those sulphur springs which have a temperature of about fifty degrees Centigrade, the Muffa first appears as tender minute filaments, soft and floating, of a greenish-white colour, surrounded by a mucilaginous milky-white substance imbued with a sulphurous deposit. Of little consistency in its early state, it soon becomes more substantial; changing in colour to violet, then light yellow, and finally to a pale green. When mature, the Muffa resembles a gelatinous lard, carpeting the rock down which the water flows. The vegetable above referred to was considered by Allioni to be *Ulva labyrinthiformis* of Linnæus. In 1837 Fontan detected a distinct organization, describing it as composed of white filaments from $\frac{1}{400}$th to $\frac{1}{200}$th of a millimètre in diameter; tubular, cylindrical, simple, devoid of septa, containing small semi-opaque globules, collocated when young, and separated towards the ends of the tubes in mature individuals. To this plant he gave the name Sulphuraria, it not having been found in any except sulphur springs. Delponte, of the Botanic Garden at Turin,

Stalactic form of the Muffa when not clinging to the rock from which it depends.

after careful microscopic examination, places it in the genus Leptothrix (Kützing), near to *L. compacta* and *L. lamellosa*, naming it after the place of its nativity, Valderia. A parasitic Ulva accompanies the above, growing upon it, and an



600. *Leptothrix valderia.*

Oscillatoria sometimes covers the upper surface, where the water has not more than thirty degrees of temperature. *Conferva nigra* also occurs.

2. The microscope reveals curious spontaneous movements in the Muffa; these are the work of numerous minute animals, which live and multiply at a temperature of forty degrees. Professor Defilippi considers them to be coleopterous insects of the genera Cryptophagus and Comurous, with others which he could not determine.

3. The residuum after burning dried Muffa was 28·055 per cent. Of this 10·924 were mineral substances belonging to the vegetable organization—*i. e.* true cinders, and 17·134

sand mixed with the vegetable, from which it had been found difficult to separate it. One hundred parts of pure cinder contained—oxide of potassium, 15,271; oxide of sodium, 11,637; oxide of calcium, 7938; oxide of magnesia, 1915; oxide of alumina, 9833; oxide of iron and manganese, 24,162; chlorine, 2445; sulphuric acid, 9232; phosphoric acid, 4481; silicious acid, 13,115.

Remarks *on the* New Nineteen-Band Test-plate *of* Nobert. By J. J. Woodward, Assistant-Surgeon and Brevet Lieut.-Col. U.S. Army.

In comparing the various object-glasses belonging to the microscopical section of the Army Medical Museum, the test-plate of Nobert has been much employed recently as the most accurate means of determining defining power. The plate used was one of the nineteen-band plates most recently furnished by Nobert; and its use for the purpose indicated has led the writer to a somewhat detailed study of the plate itself.

Nobert has at various times issued test-plates with lines of different degrees of fineness, the finest on the recent plates being much closer than those of the earlier ones.

An interesting account of these several test-plates is given in Starting's work on the microscope.* It appears from this account that the first test-plate issued by Nobert had ten bands, the lines of the 1st being ruled at the rate of 443, those of the 10th at the rate of 1964 lines to the millimeter.

In 1849 he prepared plates with twelve bands, then plates with fifteen, the 15th band having its lines ruled at the rate of 2216 to the millimeter. In 1852 he issued plates with twenty bands, the lines of the 20th band being $\frac{1}{0000}$th of a Paris line, or $\frac{1}{2664}$th of a millimeter apart.

This twenty-band plate has recently been described by Mr. Richard Beck, who gives an engraving which professes to be a view of portions of each of the twenty bands, "as shown by a $\frac{1}{8}$th with number three eyepiece × 1300 linear."†

* 'Geschichte und gegenwärtiger zustand des Mikroskops,' von P. Harting. 'Deutsche Original Ausgabe, herausgegeben,' von Dr. F. W. Theile, zweile auflage. 'Braunschweig,' 1866, band iii, s. 369.

† 'A Treatise on the Construction, Proper Use, and Capabilities of Smith, Beck, and Beck's Achromatic Microscopes,' by Richard Beck. London, 1865. Page 19, plate 8.

According to Mr. Beck, the lines of the 20th band are thirty-five in number, and are ruled at the rate of 70,000 to the English inch, which corresponds almost precisely with the statement of Starting.

Nobert subsequently prepared a test-plate with thirty bands, the lines of the 1st being the $\frac{1}{1000}$th, those of the 30th the $\frac{1}{8000}$th of a Paris line apart. He states that the lines are ruled at the following rates, for the bands named:

	No. of lines to a millimeter.		No. of lines to a millimeter.
No. 1	443	No. 20	2653
5	806	25	3098
10	1612	30	3544
15	2215		

The 20th band of the twenty-band plate corresponds nearly with the 22nd band of this plate.

An analysis of this thirty-band plate has been made by Messrs. Sullivant and Wormley,* who succeeded satisfactorily in resolving the first twenty-seven bands, and counting the lines in them. Up to the 26th band they encountered "no serious difficulty in resolving and ascertaining the position of the lines; but on this and the subsequent ones spectral lines, that is, lines each composed of two or more real lines, more or less prevailed, showing that the resolving power of the objective was approaching its limit. By a suitable arrangement, however, these spurious lines were separated into the ultimate ones on the whole of the 26th, and very nearly on the whole of the 27th band; but on the 28th, and still more on the 29th, they so prevailed that at no one focal adjustment could more than a portion (a third or a fifth part) of the width of these bands be resolved into the true lines. The true lines of the 30th band we were unable to see, at least with any degree of certainty."

Still more recently Nobert has prepared the plate of nineteen bands, mentioned at the commencement of this article.

The following statement of the distance of the lines in the several bands of this plate, with the number of lines to the millimeter for each, is taken from Starting.†

No. of band.	Distance of lines.	No. of lines to the millimeter.
1	$\frac{1}{1000}$ of a Paris line	443
2	$\frac{1}{1500}$ "	665

* "On Nobert's Test-plates, &c.," by W. S. Sullivant and T. G. Wormley. 'American Journal of Science and Arts' for January, 1861.

† Loc. cit., p. 374.

No. of band.	Distance of lines.	No. of lines to the millimeter.
3	$\frac{1}{2000}$ "	886
4	$\frac{1}{2500}$ "	1108
5	$\frac{1}{3000}$ "	1329
6	$\frac{1}{3500}$ "	1550
7	$\frac{1}{4000}$ "	1772
8	$\frac{1}{4500}$ "	1994
9	$\frac{1}{5000}$ "	2215
10	$\frac{1}{5500}$ "	2437
11	$\frac{1}{6000}$ "	2658
12	$\frac{1}{6500}$ of a Paris line	2880
13	$\frac{1}{7000}$ "	3101
14	$\frac{1}{7500}$ "	3323
15	$\frac{1}{8000}$ "	3544
16	$\frac{1}{8500}$ "	3766
17	$\frac{1}{9000}$ "	3987
18	$\frac{1}{9500}$ "	4209
19	$\frac{1}{10000}$ "	4430

It will be seen that the lines of the 15th band of this plate are the same distance apart as those of the 30th of the thirty-band plate, and those of its 11th band are the same distance apart as those of the 20th band in the twenty-band plate described by Mr. Beck.

Max Schultze* has published a short account of some observations made by him with one of these new nineteen-band plates, from which it appears that with central illumination he succeeded in resolving the ninth band with two objectives, viz., Hartnack's immersion system No. 10 and Merz's immersion system $\frac{1}{24}$. By oblique light he was able to see the true lines in the 14th band. Mr. Charles Stodder,† in a recent article on the Nobert plate, quotes the abbreviation of Schultze's article in the 'Quarterly Journal of Microscopical Science,' January, 1866, as follows:—"With oblique illumination he has not been able with any combination to get beyond the 15th." This, I think, is hardly what was intended by Schultze's somewhat ambiguous remark, "Bei Schiefem Licht bin ich mit den besten systemen bis zur 15ten gruppe gekommen," which I understand to mean that he resolved the 14th band, getting thus as far as to the 15th, which he did not resolve; an interpretation which is confirmed by the quotation made by Mr. Stodder in the same

* 'Archiv für Mikroskopische Anatomie,' erster band. Bonn, 1865, p. 305.

† "Nobert's Test-plates and Modern Microscopes." 'American Naturalist,' vol. ii, p. 97.

article from a letter recently received by him from Eulenstein, of Stutgard, in which that microscopist says, "I have myself resolved the 14th band with a $\frac{1}{12}$th of Powell and Lealand." "Nobert himself has never seen with his highest powers higher than the 14th band." Eulenstein would hardly have written thus in 1868 if Schultze had resolved the 15th band in 1865.

After commenting on the various observations hitherto published with regard to the Nobert lines, Mr. Stodder goes on to state—"With Tolles' $\frac{1}{6}$th immersion, angular aperture 170°, B eyepiece, power 550, Mr. Greenhaf and myself both saw the 19th band satisfactorily." These gentlemen, however, were not able to count the lines, and Mr. Stodder enlarges on the difficulty of counting such fine lines by any means in our possession. He says, "In counting lines of such exquisite fineness either the microscope or the stage must be moved, and it is next to impossible to construct apparatus that can be moved at once the $\frac{1}{100000}$th part of an inch and no more."

Shortly before reading Mr. Stodder's paper, I had commenced a series of observations on Nobert's nineteen-band plate. These observations have convinced me that Messrs. Stodder and Greenhaf saw spurious and not real lines, and as the difficulty of counting the lines is readily overcome by following the method I shall presently detail, I hope these gentlemen will repeat their observations, and endeavour to count the lines they see in the 19th band—an attempt which I am sure will convince them that my opinion is correct.

The following is a brief account of my own analysis of the nineteen-band plate of Nobert. The plate used is the property of the Rev. Dr. F. A. P. Barnard, President of Columbia College, New York. As in all the Nobert plates which I have seen, the lines are ruled on the under surface of a thin glass cover, which is cemented at the edges with Canada balsam to a glass slide, on which the fractions of a Paris line corresponding to the principal lines are written with a diamond.

This plate was obtained of Nobert in 1867, and by special request the ruling had been made on a cover much thinner than I have ever seen on other plates of Nobert. On trial I found that I could readily employ the $\frac{1}{25}$th of Powell and Lealand, and even with some difficulty the $\frac{1}{30}$th of the same makers.

Out of the series of lenses at my disposal, including a $\frac{1}{8}$th of Ross made two years ago, a $\frac{1}{10}$th of Tolles made five years ago, an immersion system No. 11, by Hartnack, made two

years ago, a $\frac{1}{8}$th, an immersion $\frac{1}{10}$th, and a $\frac{1}{15}$th, by Wales, &c., I obtained the best results with the $\frac{1}{25}$th and $\frac{1}{50}$th of Powell and Lealand. In illuminating the object I found it best to use the larger diaphragm opening of the achromatic condenser without any central stop, and to give obliquity to the pencil by throwing the condenser to the right or left of its true centreing. With this management and both of the above-named lenses, I at first supposed I had seen the lines of all the bands, including the 19th. On attempting to count them, however, with a good cobweb micrometer made by Stackpole, of New York, I found myself unable to get beyond the 9th or 10th band, on account of the tremor communicated to the instrument when the micrometer screw was turned. This tremor, almost imperceptible with a $\frac{1}{8}$th, appeared so considerable with a $\frac{1}{25}$th as to render an accurate count impossible. Under these circumstances, I requested my able assistant, Dr. E. Curtis, to undertake the preparation of photographs of each of the bands. This he did with the $\frac{1}{25}$th, and a distance which gave as nearly as possible 1000 diameters.

The photographs showed that the true lines had been seen up to the fifteenth band inclusive; those seen in the last four bands were spurious. A subsequent count of the lines in the last four bands, by the method to be detailed hereafter, verified this opinion. A photographic trial of the $\frac{1}{50}$th on the twelfth band did not give so sharp a picture as that of the same band obtained by the $\frac{1}{25}$th, probably because the cover was somewhat thick for this glass, for on Podura, with a suitably thin cover, the $\frac{1}{50}$th has excelled the $\frac{1}{25}$th in our hands.

The series of photographs thus obtained give the following count for the lines in each band:

1st band . .	7 lines.	11th band . .	34 lines.
2nd „ . .	10 „	12th „ . .	37 „
3rd „ . .	13 „	13th „ . .	40 „
4th „ . .	15 „	14th „ . .	43 „
5th „ . .	17 „	15th „ . .	45 „
6th „ . .	20 „	16th „	not counted.
7th „ . .	23 „	17th „ „	„
8th „ . .	25 „	18th „ „	„
9th „ . .	27 „	19th „ „	„
10th „ . .	30 „		

The photographs of these bands present the following characteristics:—In the first band, the space immediately bordering each side of the broad, deep, black lines is brighter

than the rest of the field, and a spurious line is seen in the centre of the space between the adjacent lines. In the second, third, and fourth bands, the spaces between the lines are brighter than the rest of the field, and the first and last lines of each band have a similar clear space on their outside, beyond which, again, is a line-like shadow, which, in the fourth and fifth bands, might be mistaken for additional true lines. By changing the illumination, however, the true character of these shadowy lines is plainly shown. Several such spurious lines are to be seen beyond the first and last true lines in some of the higher bands, but their true character can also be determined by changing the illumination.

In the first four bands the ruling is extremely regular, and the lines in each successive band are not only closer but finer than in the preceding ones. The same general characters are presented in the higher bands; but from the fifth band on, the difficulties in the way of ruling such fine lines evenly are not wholly overcome, and every here and there two lines are ruled too close together, with a corresponding too great distance on each side of the pair.

The photographs of the eighth band, and of those subsequent to it, would seem to indicate that the progressively greater fineness of the lines noticeable throughout is obtained by diminishing the pressure on the point by which the ruling is effected; moreover, the lines are not only at unequal distances, but are somewhat wavy, as though, perhaps, the point moved with a certain amount of tremor. These peculiarities are best appreciated by examining the photographs; but it must be confessed that the degree of regularity and precision still exhibited in the fifteenth band is truly astonishing.

The negatives of the fifteenth band show the lines perfectly defined from one edge of the band to the other, but they are so fine and close that they are indistinct in the paper prints. A copy of this negative of twice the size has, therefore, been prepared, from which prints have been made, which show the lines very well. A pale line at the right edge of this band in the photograph may, perhaps, be a real ruling, which would give 46 lines; on the whole, however, I am inclined to regard this line as a spurious one, and the real number of lines as 45.

Two photographs of the 16th, 17th, 18th, and 19th bands have also been prepared, which show spurious lines in all the bands, which in one of these photographs do not exceed thirty in number; in the other forty. In the photographs, moreover, the spurious character of these lines is plainly re-

cognised by their appearance, as well as by their number. They are pale and broad, and their margins quite unlike the sharp, clear edges of the real lines; but in the microscope, even with the $\frac{1}{50}$th of an inch, they look to the eye so like the real ones as readily to deceive. It is these spurious lines, no doubt, that Mr. Stodder saw in the 19th band, with Tolles' immersion, $\frac{1}{0}$th.

In order that no doubt of the character of these lines might remain, additional photographs have been prepared of the 12th, 13th, and 14th bands, with the illumination so arranged as to produce spurious lines. One mode of illumination gives lines which do not exceed sixteen in number in any of these bands. The other gives about twenty-five lines for the 12th band instead of forty, which is the real number. The character of the lines in the last two photographs is quite similar to that of the lines shown in the photographs of the 16th, 17th, 18th, and 19th bands.

The 15th band is therefore the highest which I have resolved with the glasses at my disposal. It corresponds to the last band of the thirty-band plate, and I believe the true lines have never been seen in it before.

It is probable that if opaque markings of still greater fineness could be produced, the same objectives would resolve them, but with the superficial scratches on glass afforded by Nobert's plate this result is not possible. Nevertheless, the opinion may be expressed that the lines of the last four bands have been ruled as Nobert claims, and that with lenses of better definition they could be seen.

I may here mention that one of the photographs of the 16th, 17th, 18th, and 12th bands, showing spurious lines, was made at the museum by Dr. Curtis, with a Wales $\frac{1}{8}$th and amplifier, a few months previous to the other photographs. I supposed at the time, and, indeed, until quite recently, that the lines shown in the 16th and 17th bands by this photograph were the real ones, and accounted for their being too few in number (the 16th counting only thirty-seven, the 17th only forty, lines) by supposing that the whole of each band was not to be seen in any one position of the focal adjustment. I have since learned more of the appearance of spurious lines, and recognise that all the lines shown in this earlier photograph were such.

I learn from Dr. Barnard that Nobert, to whom it was shown by Eulenstein, accounted for the small number of lines in this photograph by supposing that Dr. Curtis had, by mistake, copied the 12th, 13th, 14th, and 15th bands. I can assure the distinguished optician that we have made no such

error, as he will doubtless acknowledge when he examines the photographs of the 12th, 13th, 14th, and 15th bands now prepared, and copies of which I have sent him.

It only remains to indicate how the Nobert's lines may be counted, even in the highest bands, without photographing them. To do this, we set up the microscope as though to take a photograph, remove the eyepiece, receive the image on a piece of plate-glass, and view it with a focussing glass, on the field-lens of which a black point is remarked. As the focussing glass is moved on the plate from side to side, the black point is moved from line to line. The lines may thus be counted with as much ease and precision as though they were large enough to be touched by the finger.

Or they may be counted by a cobweb micrometer, if the precaution is taken to keep the micrometer eyepiece separate from the microscope, clamping it firmly about half an inch from the end of the body of the instrument on a stand, which should be screwed down to the table A piece of black velvet should be used to connect the micrometer with the microscope tube. It will now be found that turning the micrometer screw communicates no tremor to the instrument, and the lines can be counted with great ease. On the whole, I think the first of these two methods preferable.

A set of the photographs above described is herewith forwarded to the editors of this Journal.

Note.—Since writing the above, I have seen Mr. Stodder's paper reproduced in the July number of this Journal, with a note, in which he claims that Dr. Barnard had resolved the 19th band with a Spencer $\frac{1}{10}$th and a Tolles' $\frac{1}{5}$th. Dr. Barnard certainly saw lines in the 19th band, as Mr. Stodder and I have done, but undoubtedly these lines were spurious, since the counts given in Mr. Stodder's note do not agree with each other or with the true number of lines; and Dr. Barnard himself writes me, July 21st, 1868, that his opinions on the subject are not matured, and that he intends to make further observations.

Address *delivered by the* Rev. M. J. Berkeley, *President of the Biological Section of the* British Association, *at the Meeting held in Norwich, September,* 1868.

Few points are of greater significance than those which touch upon the intimate connection of animal and vegetable life. Fresh matter is constantly turning up, most clearly indicating that there are organisms in the vegetable kingdom which cannot be distinguished from animals. The curious observations which showed that the protoplasm of the spores of *Botrytis infestans* (the potato mould) is at times differentiated, and ultimately resolved into active flagelliferous zoospores, quite undistinguishable from certain infusoria, have met their parallel in a memoir lately published by MM. Famintzin and Boranetzky, respecting a similar differentiation in the gonidia of lichens belonging to the genera Physcia and Cladonia. It is, however, only certain of the gonidia which are so circumstanced; the contents of others simply divide into motionless globules.

A still more curious fact, if true, is that described by De Bary, after Cienkowsky, in the division of fungi known under the name of Myxogastres or false puff-balls. Their spores, when germinating, in certain cases give rise to a body not distinguishable from Amœba, though in others the more ordinary mode of germination prevails. In the first instance De Bary pronounced these productions to belong to the animal kingdom, so striking was the resemblance; but in our judgment he exercised a wise discretion in comprising them amongst vegetables in a late volume of Hofmeister's 'Handbuch.'

The point, however, to which I wish to draw your attention, and one of great interest if ultimately confirmed, is that the gelatinous mass produced either independently, or by the blending of these amœboid bodies, is increased, after the manner of true Amœbæ, by deriving nourishment from different organisms involved by accident from the extension of the pseudopodia. These foreign bodies, according to our author, behave themselves precisely after the same manner as those enclosed accidentally in undoubted animals. If this be true, it shows a still more intimate connection, or even identity of animals and vegetables than any other fact with which I am acquainted.

You are all doubtless aware of the important part which minute fungi bear in the process of fermentation. A very

curious contribution to our information on cognate matters has lately been published by Van Tieghem, in which he shows that tannin is converted into gallic acid by the agency of the mycelium of a species of Aspergillus, to which he has given the name of *Aspergillus niger*. The paper will be found in a late number of the 'Annales des Sciences Naturelles,' and is well worth reading.

We now come to a subject which is at present of much importance, viz. the theory of Hallier respecting the origin of certain diseases. His observations were at first confined to Asiatic cholera, but he has since made a communication to the authorities of the medical department of the Privy Council office to the effect that, in six other diseases—typhus, typhoid, and measles (in the blood), variola, variola ovina, and vaccinia (in the exanthemes)—he has found certain minute particles which he calls micrococci, which under culture experiments give, for each of the above-mentioned diseases, a constant and characteristic fungus. He states that in variola he gets the hitherto unknown pycnidia of *Eurotium herbariorum;* in vaccinia, *Aspergillus glaucus*, Lk.; in measles, the true *Mucor mucedo* of Fresenius; in typhus, *Rhizopus nigricans*, Ehrenberg; and in typhoid, *Penicillium crustaceum*, Fries. He adds that the culture experiments, especially with the variola diseases, have been so very numerous as to exclude from the results all supposition of accident —that different districts, different epidemics, and different times have given identical results. I am anxious to say a few words about the subject, because most of the reports which have been published in our medical journals give too much weight, in my opinion, to his observations, as though the matter had been brought to a logical conclusion, which is far from being the case. I am happy to say that it has been taken up by De Bary, who is so well calculated to give something like a conclusive answer to the question, and also that it has been taken in hand by the medical authorities of our army, who are about to send out two of their most promising young officers, perfectly unprejudiced, who will be in close communication, both with De Bary and Hallier, so as to make themselves perfect masters of their views, and to investigate afterwards the subject for themselves.

The fault, as I conceive, of Hallier's treatise is that, while his mode of investigation is unsatisfactory, he jumps far too rapidly to his conclusions. It is quite possible that certain fungi may occur constantly in substances of a certain chemical or molecular constitution, but this may be merely a case of effect instead of cause. Besides, as I conceive, the only

safe way of ascertaining what really originates from such bodies as those which he terms micrococci, or the larger ones commonly called yeast globules, is to isolate one or two in a closed cell so constructed that a pellicle of air, if I may so term it, surrounds the globule of fluid containing the bodies in question, into which they may send out their proper fruit —a method which was successful in the case of yeast, which consists of more than one fungus, and of the little Sclerotium, like grains of gunpowder, which is so common on onions. Any one who follows the growth of moulds on moist substances, and at different depths, as paste of wheat or rice flour, will see that numberless different modifications are assumed in different parts of the matrix, without, however, a perfect identification with fungi of other genera. Some of these will be seen in the figures I have given in the 'Intellectual Observer,' Nov., 1862, and 'Journal of Linnean Society,' vol. viii, No. 31, of different forms assumed by the moulds to which that formidable disease, the fungus foot of India, owes its origin. This is quite a different order of facts, from the several conditions assumed by the conidiiferous state of some of the vesiculiferous moulds. As, for example, *Botrytis Jonesii*, which has been ascertained to be a conidiiferous state of *Mucor mucedo*, while two forms of fruit occur of the same mould in what is called *Ascophora elegans*, or the still more marvellous modification which some of the Mucors undergo when grown in water, as evinced by some of the Saprolegniæ, the connection of which was indicated by Carus some fifty years ago, but which has never been fully investigated.

When Hallier intimates that he has raised from cholera evacuations such a parasite as *Urocystis occulta*, he should have been content with stating that a form of fructification occurred resembling, but not identical with, that fungus. Indeed, a comparison with authentic specimens of that species, published by Rabenhorst, under the generic name of Ustilago, shows that it is something very different, and yet the notion of cholera being derived from some parasite on the rice plant rests very much on the occurrence of this form. But even supposing that some Urocystis (or Polycystis, as the genus is more commonly named) was produced from cholera evacuations, there is not a particle of evidence to connect this with the rice plant. In the enormous collections transmitted by Dr. Curtis from the Southern United States, amounting to 7000 specimens, there is not a single specimen of rice with any endophytic fungus, and it is the same with collections from the East. Mr. Thwaites has made

very diligent search, and employed others in collecting any fungi which may occur on rice, and has found nothing more than a small superficial fungus nearly allied to *Cladosporium herbarum*, sullying the glumes exactly as that cosmopolitan mould stains our cereals in damp weather. Rice is occasionally ergoted, but I can find no other trace of fungi on the grains. Again, when he talks of Tilletia, or the wheat bunt, being derived from the East—supposing wheat to be a plant of Eastern origin, there is no evidence to bear out the assertion, as it occurs on various European grasses; and there is a distinct species which preys on wheat in North Carolina, which is totally unknown in the Old World.

I might enter further into the matter, were it advisable to do so at the present moment. All I wish, however, is to give a caution against admitting his facts too implicitly, especially as somewhat similar views respecting disease have lately reached us from America, and have become familiar from gaining admittance into a journal of such wide circulation as 'All the Year Round,' where Hallier's views are noticed as if his deductions were perfectly logical.

The functions of spiral vessels, or of vascular tissue in general, have long been a subject of much controversy, and few matters are of more consequence as regards the real history of the distribution of sap in plants. A very able paper on the subject, to which allusion was made by Dr. Hooker in his address, has been published by Mr. Herbert Spencer (than whom few enter more profoundly into questions of physiology) in the 'Transactions of the Linnean Society.' By a line of close argument and observation he shows, from experiments with coloured fluids capable of entering the tissues without impairing vitality, and that not only in cuttings of plants, but in individuals in which the roots were uninjured, that the sap not only ascends by the vascular tissue, but that the same tissue acts in its turn as an absorbent, returning and distributing the sap which has been modified in the leaves. That this tissue acts some important part is clear from the constancy with which it is produced at a very early stage in adventitious buds, establishing a connection between the tissues of the old and new parts. This appears also from the manner in which in true parasites a connection is established between the vascular tissue of the matrix and its parasite, as shown by our president in his masterly treatise on Balanophoræ, and more recently by Solms-Laubach in an elaborate memoir in 'Pringsheim's Journal.' It is curious that in organs so closely analogous to the tracheæ of insects a similar connection

should long since have been pointed out by Mr. Newport, in the case of certain insect parasites.

A circumstance, again, which constantly occurs in the diseases of plants confirms the views of Mr. Herbert Spencer. In diseased turnips, grapes, potatoes, &c., it is especially the vascular tissue which is first gorged with the ulmates which are so characteristic of disease.

Monsieur Casimir de Candolle, in a clever memoir on the morphology of leaves, has come to the conclusion, after studying the arrangement of their vascular tissue, that they are branches in which the side towards the axis, which he calls the posterior, is atrophied. This subject has been followed out in those organs which are considered as modifications of leaves, as, for example, stamens, in which he finds sometimes the posterior side, sometimes the anterior, atrophied. If his theory is true, this would result from the way in which they originated, and the reference they bore to contiguous organs. The subject is well worth attention, and may eventually throw considerable light on those anomalous cases in teratology which will not accommodate themselves to the usual theory of metamorphosis. Some of these cases are so puzzling and complicated, that a very clever botanist once told me, "Monstrous flowers teach us nothing,"—not meaning to abjure all assistance from them, but simply to indicate that they may be deceptive. Such flowers as double primroses, and the strange developments on the corollas of some gloxinias, may possibly receive their explanation from a careful study of the course of the vascular tissue. As the colour on the anterior and posterior order in the latter case is reversed, the doctrine of "dedoublement" does not at all help us.

Hofmeister, in his 'Handbuch der Physiologischen Botanik,' has an important chapter on free-cell formation, which at the present moment is of great interest as connected with Mr. Darwin's doctrine of Pangenesis. Mr. Rainey has shown that the formation of false cells takes place in solutions of gum and other substances; and if this is the case where no vital agency is concerned, we may well be prepared for the formation of living cells in organizable lymph, or in other properly constituted matter. The curious cell-formation of gum tragacanth may be an intermediate case. Be this, however, as it may, we have examples of free-cell formation in the formation of nuclei, in the embryos of plants, and above all in the asci of ascomycetous fungi. In plants whose cells contain nuclei new cells are never formed without the

formation of new nuclei, the number of which exactly corresponds with that of the new cells.

It would be unpardonable to finish these somewhat desultory remarks without adverting to one of the most interesting subjects of the day,—the Darwinian doctrine of Pangenesis. After the lucid manner, however, in which this doctrine was explained by Dr. Hooker in his opening address, I should be inclined to admit it altogether had I not looked at it from a somewhat different point of view, so that I should not be trespassing upon your time in going over the same ground. Others, indeed, as Owen and Herbert Spencer, have broached something of the kind, but not to such an extent, for the Darwinian theory includes atavism, reversion, and inheritance, and embraces mental peculiarities as well as physical. The whole matter is at once so complicated, and the theory so startling, that the mind at first naturally shrinks from the reception of so bold a statement. Like everything, however, which comes from the pen of a writer whom I have no hesitation, so far as my own judgment goes, in considering by far the greatest observer of our age, whatever may be thought of his theories when carried out to their extreme results, the subject demands a careful and impartial consideration. Like the doctrine of natural selection, it is sure to modify, more or less, our modes of thought. Even supposing the theory unsound, it is to be observed, as Whewell remarks, as quoted by our author, "Hypotheses may often be of service to science when they involve a certain portion of incompleteness, and even of error." Mr. Darwin says himself that he has not made histology an especial branch of study, and I have therefore less hesitation, though "impar congressus Achilli," in expressing an individual opinion that he has laid too much stress on free-cell formation, which is rather the exception than the rule. Assuming the general truth of the theory, that molecules endowed with certain attributes are cast off by the component cells of such infinitesimal minuteness as to be capable of circulating with the fluids, and in the end to be present in the unimpregnated embryo cell and spermatozoid, capable of either lying dormant or inactive for a time, or, when present in sufficient potency, of producing certain definite effects, it seems to me far more probable that they should be capable under favorable circumstances of exercising an influence analogous to that which is exercised by the contents of the pollen tube or spermatozoid on the embryo sac or ovum, than that these particles should be themselves developed into cells; and under some such modification I conceive that the theory is

far more likely to meet with anything like a general acceptation. Be this, however, as it may, its comprehensiveness will still remain the same. We must still take it as a compendium of an enormous mass of facts, comprised in the most marvellous manner within an extremely narrow compass.

I shall venture to offer a very few words in conclusion, which, perhaps, may be thought to have too theological an aspect for the present occasion.

It is obvious how open such a theory is to the charge of materialism. It is an undoubted fact, however, that mental peculiarities and endowments, together with mere habits, are handed down and subject to the same laws of reversion, atavism, and inheritance, as mere structural accidents, and there must be some reason for one class of facts as well as the other; and whatever the explanation may be, the hand of God is equally visible and equally essential in all. We cannot now refer every indication of thought and reasoning beyond the pale of humanity to blind instinct, as was once the fashion, from a fear of the inferences which might be made. Should any one, however, be still afraid of any theory like that before us, I would suggest that man is represented in Scripture as differing from the other members of the animal world, by possessing a spirit as well as a reasoning mind. The distinction between ψυχη and πνευμα, which is recognised by the Germans in their familiar words *seele* and *geist*, but which we have no words in our language* to express properly, or in other terms between mere mental powers which the rest of the creation possess in greater or less degree in common with ourselves, and an immortal spirit, if rightly weighed, will, perhaps, lead some to look upon the matter with less fear and prejudice. Nothing can be more unfair, and I may add unwise, than to stamp at once this and cognate speculations with the charge of irreligion. Of this, however, I feel assured, that the members of this Association will conclude with me in bidding this great and conscientious author God-speed, and join in expressing a hope that his health may be preserved to enrich science with the results of his great powers of mind and unwearied observation.

* A proof of this poverty of language is visible in the words used in our translation for ψυχικον and πνευματικον—natural and spiritual, their proper meaning, taken in connection with σῶμα, being a body with a soul, and a body with a spirit.

On the Nature *of the* Discoloration *of the* Arctic Seas.

By Robert Brown, Esq., F.R.G.S.*

The peculiar discoloration of some portions of the frozen ocean, differing in a remarkable degree from the ordinary blue or light green usual in other portions of the same sea, and quite independent of any optical delusion occasioned by light or shade, clouds, depth or shallowness, or the nature of the bottom, has, from a remote period, excited the curiosity or remark of the early navigators and whalemen, and to this day is equally a subject of interest to the visitor of these little-frequented parts of the world. The eminent seaman, divine, and *savant*, William Scoresby, was the first who pointedly drew attention to the subject, but long before his day the quaint old searchers after a North-west Passage "to Cathay and Zipango" seem to have observed the same phenomenon, and have recorded their observations, brief enough it must be acknowledged, in the pages of 'Purchas—His Pilgrimes.' Thus, Henry Hudson, in 1607, notices the change in the colour of the sea, but has fallen into error when he attributes it to the presence or absence of ice, whether the sea was blue or green—mere accidental coincidences. John Davis, when, at even an earlier date, he made that famous voyage of his with the "Sunshine" and the "Moonshine," notes that, in the strait which now bears his name, "the water was black and stinking, like unto a standing pool." More modern voyagers have equally noted the phenomenon, but without giving any explanation, and it is the object of this paper to endeavour to fill up that blank in the physical geography of the sea. In the year 1860 I made a voyage to the seas in the vicinity of Spitzbergen and the dreary island of Jan Mayen, and subsequently a much more extended one through Davis' Straits to the head of Baffin's Bay, and along the shores of the Arctic regions lying on the western side of the former gulf, during which I had abundant opportunities of observing the nature of this discoloration. At that period I arrived at the conclusions which I am now about to state. In the course of the past summer I again made an expedition to Greenland, passing several weeks on the outward and homeward passages in portions of the seas mentioned, during which time I had an opportunity of confirming the observations I had made seven years pre-

* Read before the Edinburgh Botanical Society, December 12, 1867, and printed in the 'Journal of Botany' for March, 1868.

viously, so that I consider that I am justified in bringing my researches, so far as they have gone, before the Botanical Society.

1. *Appearance and Geographical Distribution of the Discoloured Portions of the Arctic Sea.*—The colour of the Greenland Sea varies from ultramarine blue to olive-green, and from the most pure transparency to striking opacity, and these changes are not transitory, but permanent.* Scoresby, who sailed during his whaling voyages very extensively over the Arctic Sea, considered that in the "Greenland Sea" of the Dutch—the "Old Greenland" of the English—this discoloured water formed perhaps one fourth part of the surface between the parallels of 74° and 80° north latitude. It is liable, he remarked, to alterations in its position from the action of the current, but still it is always renewed near certain localities year after year. Often it constitutes long bands or streams lying north and south, or north-east and south-west, but of very variable dimensions. "Sometimes I have seen it extend two or three degrees of latitude in length, and from a few miles to ten or fifteen leagues in breadth. It occurs very commonly about the meridian of London in high latitudes. In the year 1817 the sea was found to be of a blue colour and transparent all the way from 12° east, in the parallel of 74° or 75° north-east, to the longitude of 0° 12′ east in the same parallel. It then became green and less transparent; the colour was nearly *grass green*, with a shade of black. Sometimes the transition between the green and blue waters is progressive, passing through the intermediate in the space of three or four leagues; at others it is so sudden that the line of separation is seen like the rippling of a current; and the two qualities of the water keep apparently as distinct as the waters of a large muddy river on first entering the sea."† In Davis' Straits and Baffin's Bay, wherever the whalers have gone, the same description may hold true —of course making allowances for the differences of geographical position, and the discoloured patches varying in size and locality. I have often observed the vessel in the space of a few hours, or even in shorter periods of time, sail through alternate patches of deep black, green, and cærulean blue; and at other times, especially in the upper reaches of Davis' Straits and Baffin's Bay, it has ploughed its way for fifty or even a hundred miles through an almost uninterrupted space of the former colour. The opacity of the water

* Scoresby, 'Arctic Regions,' vol. i, p. 175.
† Ibid, p. 176.

is in some places so great that "tongues" of ice and other objects cannot be seen a few feet beneath the surface.

2. *Cause of the Discoloration.*—These patches of discoloured water are frequented by vast swarms of the minute animals upon which the great "Right whale" of commerce (*Balæna mysticetus*, Linn.) alone subsists, the other species of Cetacea feeding on fishes proper, and other highly-organised tissues. This fact is well known to the whalers, and, accordingly, the "black water" is eagerly sought for by them, knowing that in it is found the food of their chase, and, therefore, more likely the animal itself. From this knowledge, and from observations made with the usual lucidity of that distinguished observer, Captain Scoresby attributed the nature of the discoloration to the presence of immense numbers of Medusæ in the sea, and his explanation has been accepted by all marine-physical geographers; and for more than forty years his curious estimate of the numbers of individual Medusæ contained in a square mile of the Greenland sea has become a standard feature in all popular works on zoology, and a stock illustration with popular lecturers. In 1860, and subsequently, whilst examining microscopically the waters of the Greenland sea, I found, in common with previous observers, that not only were immense swarms of animal life found in these discoloured patches, but that it was almost solely confined to these spaces. In addition, however, I observed that the discoloration was not due to this *medusoid* life, but to the presence of immense numbers of a much more minute object—a beautiful moniliform diatom, and it is this diatom which brings this paper within the ken of botanists. On several cold days, or from no apparent cause, the Medusæ, great and small, would sink, but still the water retained its usual colour, and on examining it I invariably found it to be swarming with Diatomaceæ—the vast preponderance of which consisted of the diatom referred to.

It had the appearance of a minute beaded necklace about $\frac{1}{400}$ part of an inch in diameter, of which the articulations are about $1\frac{1}{2}$ or $1\frac{1}{4}$ times as long as broad. These articulations contain a brownish-green granular matter, giving the colour to the whole plant, and again through it to the sea in which it is found so abundantly. The whole diatom varies in length, from a mere point to $\frac{1}{10}$ of an inch, and appears to be capable of enlarging itself indefinitely longitudinally by giving off further bead-like articulations. Wherever, in those portions of the sea, I threw over the towing-net, the muslin in a few minutes was quite brown with the presence of this alga in its meshes. Again, this summer, I have had

occasion to notice the same appearance in similar latitudes on the opposite shores of Davis' Straits where I had principally observed it in 1860. This observation holds true of every portion of discoloured water which I have examined in Davis' Straits, Baffin's Bay, and the Spitzbergen or Greenland Seas, viz., that wherever the green water occurred the sea abounded in Diatomaceæ, the contrary holding true regarding the ordinary blue water. These swarms of diatoms do not appear to reach in quantity any very great depth, for in water brought up from 200 hundred fathoms there were few or no diatoms in it. They seem also to be affected by physical circumstances, for, sometimes in places where a few hours previously the water on the surface was swarming with them, few or none were to be found, and in a few hours they again rose. But the diatom I found plays another part in the economy of the Arctic Seas. In June, 1860, whilst the iron-shod bows of the steamer I was on board of crashed their way through among the breaking-up floes of Baffin's Bay, among the Women's Islands, I observed that the ice thrown up on either side was streaked and coloured brown, and on examining this colouring matter I found that it was almost entirely composed of the moniliform diatom I have described as forming the discolouring matter of the iceless parts of the icy sea. I subsequently made the same observation in Melville Bay, and in all other portions of Davis' Straits and Baffin's Bay where circumstances admitted of it. During the long winter the Diatomaceæ had accumulated under the ice in such abundance that when disturbed by the pioneer prow of the early whalers they appeared like brown slimy bands in the sea, causing them to be mistaken more than once for the waving fronds of *Laminaria longicruris* (De la Pyl.) (which, and not *L. saccharina*, as usually stated, is the common tangle of the Arctic Sea). On examining the under surface of the upturned masses of ice, I found the surface honey-combed, and in the base of these cavities vast accumulations of Diatomaceæ, leading to the almost inevitable conclusion that a certain amount of heat must be generated by the vast accumulations of these minute organisms, which thus mine the giant floes, so fatal in their majesty, into cavernous sheets. These are so decayed in many instances as to be easily dashed on either side by "ice-chisels" of the steamers which now form the greater bulk of the Arctic-going vessels, and they get from the seamen, who too frequently mistake cause for effect, the familiar name of "rotten ice." I find that, as far as the mere observation concerning the diatomaceous character of these slimy masses

is concerned, I was forestalled by Dr. Sutherland (Appendix to 'Penny's Voyage,' cxcviii, and vol. i, pp. 91, 96). This gives me an opportunity of remarking that though one diatom, as I have remarked, predominates, yet vast multitudes are there of many different species, and even protozoa are included; for though Dr. Sutherland expressly states that this brown slimy mass was principally composed of the moniliform diatom spoken of, yet Professor Dickie (now of Aberdeen) found in it also *Grammonema Furgensii*, Ag., *Pleurosigma Thuringica*, Kg., *P. fasciola*, *Triceratium striolatum*, Naviculæ, Surirellæ, &c. Is it, therefore, carrying the doctrine of final causes too far to say that these diatoms play their part in rendering the frozen north accessible to the bold whalemen, as I shall presently show they do, in furnishing subsistence to the giant *quarry* which leads them thither?

I have spoken of the discoloured portions of the Arctic Sea as abounding in animal life, and that this life was nowhere so abundant as in these dark spaces which owe this hue to Diatomaceæ.

These animals are principally various species of Beroidæ, and other Steganophthalmous Medusæ; Entomostraca, consisting chiefly of *Arpacticus Kronii*, *A. Chelifer* and *Cetochilus articus*, septentrionalis; and pteropodous mollusca, the chief of which is the well-known *Clio borealis*, though I think it proper to remark that this species does not contribute to the whales' food nearly so much as we have been taught to suppose. The discolored sea is sometimes perfectly thick with the swarms of these animals, and then it is that the whaler's heart gets glad as visions of "size whales" and "oil money" rise up before him, for it is on these minute animals that the most gigantic of all known beings solely subsists. What, however, was my admiration (it was scarcely surprise) to find, on examining microscopically the alimentary canals of these animals, that the contents consisted entirely of the Diatomaceæ which give the sable hue to portions of the Northern Sea in which these animals are principally found! It thus appears that, in the strange cycle of nature, the "whales' food" is dependent upon this diatom! I subsequently found (though the observation is not new) that the alimentary canals of most of the smaller Mollusca, Echinodermata, &c., were also full of these Diatomaceæ. I also made an observation which is confirmatory of what I have advanced regarding the probability of these minute organisms giving off *en masse* a certain degree of heat, though in the individuals inappreciable to the most delicate of our instru-

ments. On the evening of the 4th of June, 1867, in latitude 67° 26′ N., the sea was so full of animal (and diatomaceous) life that in a few minutes upwards of a pint measure of Entomostraca, Medusæ, and Pteropoda would fill the towing-net. The temperature of the sea was then, by the most delicate instruments, found to be 32·5° Fahr., and next morning (June 5th), though the air had exactly the same temperature, no ice at hand, and the ship maintained almost the same position as on the night previous, yet the surface temperature of the sea had sunk to 27·5° Fahr., and was clear of life—so much so, that in the space of half an hour the towing-net did not capture a single Entomostracon, Medusa, or Pteropod. I also found that this swarm of life ebbed and flowed with the tide, and that the whalers used to remark that whales along shore were most frequently caught at the flow of the tide, coming in with the banks of whales' food. This mass of minute life also ascends to the surface more in the calm arctic nights when the sun gets near the horizon during the long, long summer. In 1860 I was personally acquainted with the death of thirty individuals of the "right whalebone whale" (*Balæna mysticetus*, L.), and of this number fully three fourths were killed between ten o'clock p.m. and six o'clock a.m., having come upon the "whaling grounds" at that period (from amongst the ice where they had been taking their *siesta*) to feed upon the animals which were then swarming on the surface, and these again feeding on the Diatomaceæ found most abundantly at that time in the same situations. I would, however, have you to guard against the supposition, enunciated freely enough in some compilations, that the whales' food migrates, and that the curious wanderings of the whale north, and again west and south, is due to its "pursuing its living;" such is not the case. The whales' food is found all over the wandering ground of the Mysticete, and in all probability the animal goes north in the summer in pursuance of an instinct implanted in it to keep in the vicinity of the floating ice-fields (now melted away in southern latitudes); and again it goes west for the same purpose, and finally goes south at the approach of winter—but where, no man knows. There are some other streaks of discoloured water in the Arctic Sea, known to the whalers by various not very euphonious names, but these are merely local or accidental, and are also wholly due to Diatomaceæ, and with this notice may be passed over as of little importance. I cannot, however, close this paper without remarking how curiously the observations I have recorded afford illustrations of representative species in dif-

ferent and widely separated regions. In the Arctic Ocean the *Balæna mysticetus* is the great subject of chase, and in the Antarctic and Southern Seas the hardy whalemen pursue a closely allied species, *Balæna australis*. The northern whale feed upon a *Clio borealis* and *Cetochilus septentrionalis;* the southern whale feeds upon their representative species, *Clio australis* and *Cetochilus australis*, which streak with crimson the Southern Ocean for many a league. The Northern Sea is dyed dark with a diatom on which the Clios and Cetochili live, and the warm waters of the Red Sea are stained crimson with another; and I doubt not but that, if the Southern Seas were examined as carefully as the Northern have been, it would be found that the southern whales' food lives also on the diatoms staining the waters of that Austral Ocean.

I do not claim any very high credit for the facts narrated in the foregoing paper, either general or specific, for really it is to the exertions of the ever-to-be-admired sailor-*savant*, William Scoresby, that the first faint light which has led to the question is due, though the state of science in his day would not admit of his seeing more clearly into the dark waters of that frozen sea he knew and loved so well.

At the same time I believe that I am justified in concluding that we have now arrived at the following conclusions from perfectly sound data, viz.:—

1. That the discoloration of the Arctic Sea is due not to animal life, but to Diatomaceæ.
2. That these Diatomaceæ form the brown staining matter of the "rotten ice" of Northern navigators.
3. That these Diatomaceæ form the food of the Pteropoda, Medusæ, and Entomostraca, on which the *Balæna mysticetus* subsists.

I have brought home abundant specimens of the diatomaceous masses which I have so frequently referred to in this paper, and I am now engaged in distributing them to competent students of this order, so that the exact species may be determined; but as these take a long time to be examined (more especially as diatoms do not seem so popular a study as they were a few years ago), I have thought it proper to bring the more important general results of my investigations before you at this time, and to allow the less interesting subject of the determination of species to lie over to another time. I have to apologise to you for introducing so much of another science, foreign to the objects of the society, into this paper; but when the lower orders of plants are concerned, we are so near to the boundaries of the animal world, that to

cross now and then over the shadowy march is allowable, if not impossible to be avoided.

Finally, you will allow me to remark that, in all the annals of biology, I know nothing more strange than the curious tale I have unfolded: the diatom staining the broad frozen sea, again supporting myriads of living beings which crowd there to feed on it, and these again supporting the huge whale,—so completing the wonderful cycle of life. Thus it is no stretch of the imagination to say that the greatest animal in creation,* whose pursuit gives employment to many thousand tons of shipping and thousands of seamen, and the importance of which is commercially so great that its failure for one season was estimated for one Scottish port alone at a loss of £100,000 sterling,† depends for its existence on a being so minute that it takes thousands to be massed together before they are visible to the naked eye; and, though thousands of ships have for hundreds of years sailed the Arctic, unknown to the men who were most interested in its existence; illustrating in a remarkable degree how nature is in all her kingdoms dependent on all—and how great are little things!

On the Occurrence *of* Living Forms *in the* Hot Waters *of* California. By Arthur Mead Edwards.

(In a letter to the Editors of the 'Am. Jour. Sci.,' dated 49, Jane Street, N. Y., Jan. 23, 1868.)

In the May (1866) number of the 'American Journal of Science' were some notes by Prof. Brewer on the occurrence of living forms in the hot and saline waters of California, in which a slight error appeared, tending to mislead naturalists more particularly with regard to certain observations of mine. In the subsequent number for November Prof. Brewer inserted a note making a correction in this matter, but, as the subject is one of importance, I have taken the liberty of putting together a few notes relating thereto, and beg of you to insert them at your convenience.

* Nilsson, in his 'Skandinaviske Fauna,' vol. i, estimates the full-grown *B. mysticetus*, at 100 tons, or 220,000 lbs., or equal to 88 elephants or 442 white bears.

† In 1867 the twelve screw steamers of Dundee only took two whales, and the loss to each steamer was estimated at £5000, and to the town in all at the sum I have given.

The facts in the case of the Californian water are as follows:—Prof. Brewer was under the impression that I had found animal as well as vegetable organisms in several specimens collected by him during the prosecution of the State Geological Survey, and so wrote. I received but one specimen from hot or saline water, and that was gathered at the Geysers, in water of a temperature of 120½° F. Unfortunately the rest of the collections made at this and similar localities did not come into my hands, but I have arranged so that I shall before long have specimens of this description, and doubtless the examination of them will throw much light upon the subject under consideration. Of the material I did receive the amount was very small, and I made, as I had been requested, a very careful examination, with these results. I found it to consist mostly of fine sand, mixed with a little of what seemed to be the refuse of decaying vegetation, which we might easily understand would be blown or otherwise carried into the Geyser. Besides these substances, I found it to contain a very few frustules of Diatomaceæ; true aquatic plants. They are an *Orthosira*, most likely *O. crenulata* of Kützing, which is the same as *Gaillionella crenulata*, Ehr., and has been placed under *Orthosira orichalcea*, W. S., and by Smith in his 'Synopsis.' The number of frustules of this species is small, but enough for its determination. Besides this, I found perhaps half a dozen frustules of Fragillaria, most likely *F. capucina*, Desm., which is synonymous with *F. rhabdosoma*, Ehr. I also saw a fragment of a much larger species, which looked as if it were *Cocconema lanceolatum*, Ehr., but, as the piece was very small, I cannot be certain. There are also present some hollow hairs or spines which might have belonged to aquatic crustaceans, but are of a dark brown colour, and therefore I am of opinion were derived from some insect, and of extraneous origin. It will thus be seen that what I found in the single specimen I examined hardly bears out Prof. Brewer's remarks on the occurrence of living organisms in these hot waters. The only organized matters I detected were the siliceous loricæ of Diatomaceæ, which we have no proof were living in the water of the Geyser, and might, on account of their extreme minuteness, be carried from a distance, and the hollow spines or hairs which I am convinced are of insect origin. In connection with this matter and bearing upon it in a very close manner, it will be as well to mention here, and thus place upon record, one or two facts to which it may be desirable to refer at some future time. In the number for January, 1867, vol. iii, of Max Schultze's

'Archiv für Mikroskopische Anatomie' is a paper by Ferdinand Cohn, of Breslau, entitled "Researches on the Physiology of the Phycochromaceæ Florideæ." Therein, besides mentioning many facts of interest to students of vegetable physiology, he states that certain Oscillariæ, namely, the Beggiatoa (one of which, *B. mirabilis*, bends and twists itself in a very remarkable manner, so that it produces vermicular waves and a motion looking like the peristaltic action of the bowels), which live in waters charged with sulphates at a high temperature, and hence, during the process of their growth, decompose the salt present and cause the evolution of free sulphuretted hydrogen. In the abstract of Dr. Cohn's paper in the 'Quarterly Journal of Microscopical Science' the writer remarks that Dr. C. says, "Since this group of algæ alone can flourish in hot and strongly saline solutions, it is probable that the first organisms which were present in the primordial sea which covered the earth, and was of very high temperature, if we may reason from the deductions of geologists, were Oscillariæ, or rather Chroococcaceæ." Now, in the hot springs of California there have been found Oscillariæ probably belonging to this order, besides Diatomaceæ. Prof. Whitney says ('Geology of California,' vol. i, p. 94), "Both the earth and the stream are highly charged with sulphuretted hydrogen and sulphurous acid, and the waters hold in solution a great variety of salts, especially sulphates of iron, lime, and magnesia; these salts, as well as crystallized sulphur, are deposited over the rocks in the cañon, giving a peculiar and vivid colouration, which is perhaps the most striking feature of the place." This is also confirmatory of the supposition of the growth of plants of this kind in these springs, and it is easy to understand how the sulphur can be eliminated from the sulphates, or even the oxygen abstracted by the vegetation, during the period of its life, and sulphides deposited. In fact, the dark-coloured iron sulphide is particularly mentioned by Prof. Whitney as found in abundance at the Geysers. Furthermore, in the number of the 'London Quarterly Journal of Microscopical Science' for July, 1867, is a paper by Dr. Lauder Lindsay, "On the Protophyta of Iceland," wherein he mentions that in the Geysers of that country grow Confervæ and Diatomaceæ, of which latter he enumerates seven genera, and says "the abundance of diatoms in the thermal waters of Central and Southern Europe warrants us in expecting large additions to the Icelandic Diatomaceæ from this source alone." Now, it would be of extreme interest to ascertain in what way and to what degree the saline and hot waters affect

species of Diatomaceæ, as collections might be made in fresh water if it occurs near the hot springs.

Besides, these forms from the saline as well as from the fresh waters of the Pacific coast should be very carefully compared with those found in the immense deposits so common in that part of the world; one of which deposits Frémont found on the Columbia River, and others have been detected by the State Geological Survey of California in that state and elsewhere. The origin of these deposits, and all facts connected with them, are of especial importance at the present time. It must, at the same time, be remembered that the fact as to what constitutes a species in the Diatomaceæ is by no means settled, as less really is known of the life history of these minute organisms than of almost any other plants. Moreover, in the study of the Diatomaceæ and allied families the observer has presented to him extremely advantageous opportunities of making himself acquainted with many points in the phenomena of cell-life in simple as well as more complex plants and animals. I therefore ask the co-operation of every one at all interested in the prosecution of science and the acquisition of knowledge to the furtherance of this branch of study; and to such as are able and willing to collect I will furnish plain printed directions, and to all who desire to pursue this branch of investigation I will gladly furnish all the assistance in the shape of information and specimens in my power.

NOTES *on some* ALGÆ *from a* CALIFORNIAN HOT SPRING. By Dr. H. C. WOOD, Jun., Professor of Botany in the University of Pennsylvania. — ('American Journal Science,' July, 1868).

SOME time since Professor Leidy handed me for examination a number of dried Algæ, which he had received from Professor Seidensticker, by whose sister, Mrs. Partz, they had been gathered in the Benton Spring, which is situated in the extreme northern point of Owen's Valley, California, sixty miles south-west from the town of Aurora. Afterwards a number of similar specimens came to me directly from Mrs. Partz by mail. The subject of life in thermal springs is one of so much general interest, especially in connection with that of spontaneous generation, as to induce me to

make a very careful examination of the material and offer the results to the readers of this journal. In this connection the following extract from a letter of Mrs. Partz to her brother is very relevant:

"I send you a few samples of the singular vegetation developed in the hot springs of our valley. These springs rise from the earth in an area of about eighty square feet, which forms a basin or pond that pours its hot waters into a narrow creek. In the basin are produced the first forms, partly at a temperature of 124°—135° Fahr. Gradually in the creek and to a distance of 100 yards from the springs are developed, at a temperature of 110°—120° Fahr., the Algæ, some growing to a length of over two feet, and looking like bunches of waving hair of the most beautiful green. Below 100 Fahr., these plants cease to grow, and give way to a slimy fungus growth, though likewise of a beautiful green, which, finally, as the temperature of the water decreases, also disappears. They are very difficult to preserve, being of so soft and pulpy a nature as not to bear the least handling, and must be carried in their native hot water to the house, very few at a time, and floated upon paper. After being taken from the water and allowed to cool they become a black pulpy mass. But more strange than the vegetable are the animal organizations, whose germs, probably through modifications of successive generations, have finally become indigenous to these strange precincts. Mr. Partz and myself saw in the clear water of the basin a very sprightly spider-like creature running nimbly over the ground, where the water was 124° Fahr., and on another occasion dipped out two tiny red worms."

In regard to the temperatures given, and the observation as to the presence of animal life in the thermal waters, Mr. Wm. Gabb, of the State Geological Survey, states that he has visited the locality, knows Mrs. Partz very well, and that whatever she says may be relied on as accurate.

The colour of the dried specimen varies from a very elegant bluish green to dirty greenish and fuscous brown. After somewhat prolonged soaking in hot water, the specimens regained apparently their original form and dimensions, and were found to be in very good condition for microscopical study.

The plant in its earliest stages appears to consist simply of cylindrical filaments, which are so small that they are resolved with some difficulty into the component cells by a first-class one-fifth objective. Fronds composed entirely of filaments of this description were received. Some of these

were marked as "first forms," and as having grown in water at a temperature of 160° Fahr. Probably these were collected immediately over the spot where the heated water bubbled up. At this temperature, if the collection made is to be relied on as the means of judging, the plant does not perfect itself. To the naked eye these "first forms" were simply membranous expansions, of a vivid green colour and indefinite size and shape, scarcely as thick as writing-paper, with their edges very deeply cut and running out into a long waving hair-like fringe. Other specimens, which grew at a much lower temperature, exactly simulated those just described, both in general appearance and microscopical characters.

These, I believe, were the immature plant.

The matured fronds, as obtained by the method of soaking above described, were "gelatinous membranous," of a dirty greenish or fuscous brown at their bases, and bright green at their marginal portions, where they were deeply incised and finally split up into innumerable hair-like processes. Proximally they were one, or even two, lines in thickness, distally they were scarcely as thick as tissue paper. Their bases were especially gelatinous, sometimes somewhat transculent, and under the microscope were found to have in them only a few distant filaments.

Two sets of filaments were very readily distinguished in the adult plant. The most abundant of these, and that especially found in the distal portions of the fronds, were composed of uniform cylindrical cells, often enclosed in a gelatinous sheath. The diameter of such filaments varies greatly; in the larger the sheaths are generally apparent, in the smaller they are frequently indistinguishable.

In certain places these filaments are more or less parallel side by side, and are glued together in a sort of membrane. It is only in these cylindrical filaments that I have been able to detect heterocysts, which are not very different from the other cells; they are about one-third or one-half broader, and are not vesicular, but have contents similar to those of the other cells. In one instance only was I able to detect hairs upon these heterocysts.

The larger filaments are found especially near the base and in the other older portions of the frond. Their cells are generally irregularly elliptical or globose, rarely are they cylindrical. They are mostly of an orange-brown colour; and there exists a particular gelatinous coating to each cell rather than a common gelatinous sheath to the filament.

These larger threads are apparently produced from the smaller filaments by a process of growth.

Near the base and in the under portions of the fronds, these filaments are scattered in the homogeneous jelly in which they run infinitely diverse courses. In the upper portions of the frond, and at some little distance from the base, the adjoining cells are very close to one another, and pursue more or less parallel courses, with enough firm jelly between to unite them into a sort of membrane.

This plant certainly belongs to the Nostochaceæ, and seems a sort of connecting link between the genera Hormosiphon of Kützing and Nostoc.

The best algologists now refuse to recognise the former group as generically distinct; and the characters presented by this plant seem to corroborate that view.

The species appears to be an undescribed one; and I would propose for it the specific name Caladarium, which is suggested by its place of growth. There are several species of allied genera, which grow in the hot springs of Europe; but no true Nostoc has, I believe, been found before in thermal waters. The following is the technical description of the species:

N. caladarium, sp. nov.

N. thallo maximo, indefinite expanso, aut membranaceo-coriaceo vel membranaceo-gelatinoso vel membranaceo, aut læte virdi vel sordide olivaceo-viridi vel olivaceo-brunneo, irregulariter profunde laciniato-sinuato, ultimo eleganter laciniato; trichomatibus inæqualibus, interdum flexuoso-curvatis, plerumque subrectus et arcte conjunctis, in formis duabus occurentibus: forma altera parva, viridis, articulis cylindricis, cum cellulis perdurantibus hic illic interjectis, vaginis interdum obsoletis, sæpius diffluentibus, instructa; forma altera maxima, articulis globosis vel oblongis, aurantiaco-brunneis, cellulis perdurantibus ab ceteris haud diversis.

Diam. Cellulæ cylindricæ maximæ $\frac{1}{10000}$ unc.; cellulæ perdurantis $\frac{1}{6000}$ unc.

Diam. Formæ primæ articuli maximi $\frac{1}{10000}$ unc.; cellulæ perdurantis $\frac{1}{6000}$ unc. Formæ secundæ articuli longi $\frac{1}{20000}$ to $\frac{1}{3000}$ unc., lati $\frac{1}{5000}$ to $\frac{1}{6500}$, articuli globosi $\frac{1}{3500}$ to $\frac{1}{4000}$ unc.

Adherent to, and often more or less imbedded in, the fronds of the Nostoc, were scattered frustules of several species of diatoms, none of which was I able to identify. In some of the fronds there were numerous unicellular Algæ, all of them representatives of a single species belonging to

the genus Chroococcus, Nägeli. This genus contains the very lowest known organisms—simple cells without nuclei, multiplying, as far as known, only by cell-division. These cells are found single or associated in small families; and in certain species these families are united to form a sort of indeterminate gelatinous stratum. In these species the families are composed of but very few cells, surrounded by a very large, more or less globular or elliptical mass of transparent firm jelly. The species is very closely allied to *Chroococcus turgidus*, var. *thermalis*, Rabenh., from which it differs in the outer jelly not being lamellated.

The following is the technical description of the species:

C. thermophilis, sp. nov.

Ch. cellulis singulis aut geminis vel quadrigeminis et in familias consociatis, oblongis vel subglobosis, interdum angulosis, haud stratum mucosum formantibus; tegumento crassissimo, achroo, haud lamelloso, homogeneo; cytioplasmate viridi, interdum subtiliter granulato, interdum homogeneo.

Diam. Cellulæ singulæ sine tegumento longitudo maxima $\frac{1}{1300}''$ latitudo maxima $\frac{1}{2300}''$.

TRANSLATIONS.

On the Multiplication *and* Reproduction *of the* Diatomaceæ. By the Conte Ab. Francesco Castracane degli Antelminelli.

(From the 'Atti dell' Academia pontificia dè Nuovi Lincei,' April 19, 1868.)

The numerous improvements in the microscope, of late years, have made us acquainted with an infinite number of new forms belonging to the lower divisions of the vegetable kingdom, and especially to the Diatomaceæ, the known number of which has advanced from the two or three species which had been distinguished at the end of the last century, to not less, according to Brébisson, than 2000 at the present time. But however great this addition to the number of facts serving to elucidate the natural history of these most interesting organisms may have been, the same cannot, unfortunately, be said regarding our knowledge of their organic development and general economy. This lamentable condition of things must be attributed to the too natural desire which observers entertain to associate their name with the discovery of a new form, to which end, consequently, the majority devote themselves. And an additional reason may be found in the difficulties which are met with in the investigation of the mode of development of organisms of such astonishing minuteness, which renders it almost a matter of chance when we are able to observe the various phases of the organic life of the Diatomaceæ. Whence arises the necessity of examining with the utmost attention everything that is presented in the field of the microscope, and especially in the case of living diatoms, which should be daily observed at all seasons to enable us to watch all the epochs of their development.

The apparent function of the Diatomaceæ in the economy of nature, viz. to vivify, as it were, the immensity of the ocean, as well as all fresh and brackish waters, decomposing, as they do, carbonic acid under the influence of light, and

consequently giving off oxygen, is sufficient to show that organisms of such excessive minuteness must be endowed with an extraordinary reproductive capacity in order to supply, by their number, the vast scope of the office they are destined to fulfil. Their most obvious mode of reproduction or multiplication is by a process of spontaneous division or *fissiparity*, similar to that which is seen to take place in the unicellular algæ and *protophyta* generally, and as may also be said to be universal in the vegetable cell. This process of division is effected in the same way as in the *Desmidieæ*, commencing with an internal movement in the granular substance or endocrome, which exhibits a tendency to separate into two portions. These separate portions become applied to the extremities of the cell, that is, to the two valves, whilst at the same time may be observed the secretion of two siliceous *lamellæ* or valves, which are probably invested with a delicate mucous layer (or membrane) on either surface. These two siliceous *lamellæ* are the counterparts of the two primitive valves, and exhibit the same markings and structural peculiarities. In this way the primitive cell ultimately becomes divided into two cells, each formed of an old and new valve, and each having a siliceous border or *cingulum*, in the way I have on another occasion observed, at any rate, in the genera *Navicula*, *Pinnularia*, *Stauroneis*, *Eunotia*, and *Grammatophora*.

In some species the two frustules or individuals after division remain free, and enjoy an individual, independent life, and in turn undergo a new division. In many other species the two new frustules continue more or less adherent to each other at one of the angles, as takes place in *Diatoma*, *Grammatophora*, *Tabellaria*, *Isthmia*, and *Biddulphia*; or closely applied side to side, as in *Odontidium*, *Himantidium*, *Denticula*, *Meridion*; or, finally, remain imbedded in an amorphous mucuous substance, or disposed in tubes or fronds.

This process of multiplication in the *Diatomaceæ* is a generation and an extension of the individual life, of which an infinitude of instances will at once present themselves to any one accustomed to consider the general laws of the vegetable kingdom. But every plant which is capable of multiplication, by gemmation or offsets, is more commonly reproduced by seed. It cannot, therefore, be supposed that the highly interesting class of the Diatomaceæ is not also capable of true and proper reproduction by seeds or by germs. With respect to this, we may refer to the statement contained in the classical work of Mr. W. Smith, 'Synopsis of British Diatomaceæ,' founded on his own observations, and on

those of Thwaites, Griffith, and Carter. According to these observers, cases of conjugation have been noticed in the *Diatomaceæ* similar to that which occurs in the *Desmidieæ*, and this in thirty-one distinct species belonging to seventeen *genera*; and from which conjugation resulted the formation of one or two *sporangia*, and of one or two sporangial frustules.

According to Mr. Smith, the various conditions which accompany the state of conjugation may be ranged in four classes—1. From the two conjugate frustules are produced two *sporangia*, as in the *genera Epithemia*, *Cocconema*, *Encyonema*, and *Colletonema*. 2. From the conjugation of two frustules arises a single sporangium, as is witnessed in *Himantidium*. 3. The two valves of a single frustule separate, the contents increase rapidly in volume, and finally become condensed into a single *sporangium*, as has been observed in *Cocconeis*, *Cyclotella*, *Melosira*, *Orthosira*, and *Schizonema*. 4. Lastly, from the two valves of a single frustule as above, results, by a process of conjugation, the formation of two *sporangia*, as in the *genera Achnanthes* and *Rhabdonema*.

The formation of one or of two *sporangia*, the result of the process of conjugation, can only be regarded as a reproduction of the species by germs, which is the most ordinary mode by which plants are propagated, the *sporangium* in the present case being considered as the organ destined to elaborate and emit the fecundated germs. But all this is at the present time involved in such obscurity that the author of the 'Synopsis of British Diatomaceæ' merely observes that it "seems to him" that the result of the *sporangium* may be the production of a swarm of diatoms.

Nor does Dr. Carpenter, in his valuable work, 'The Microscope and its Revelations,' appear to be more explicit on this point, saying only that he is inclined to believe in the multiplication of the Diatomaceæ by the subdivision of the endochrome in the *gonidia*, from which they emerge either in the active condition of zoospores or in the state of hypnospores. For this doubtful observation he relies upon the authority of Focke, who, in relating certain observations relative to the multiplication by germs, makes use of the argument from analogy with what takes place in other protophytes, which, besides possessing the faculty of organic multiplication by fission of the cell, are also capable of being formed by the ordinary method proper to all organisms, both vegetable and animal, in which reproduction is effected by sexual conjunction.

Moreover, various observations have already been recorded,

from which it appears to me that it may be concluded and positively admitted beyond all doubt that in the *Diatomaceæ* reproduction takes place by means of germs emitted from the *sporangia* and sporangial frustules. And in the first place it should be remarked that, whilst the existence of sporangial frustules, very easily distinguishable by their unusual size, can be recognised, we may at the same time note their paucity in proportion to the ordinary frustules—a circumstance that (if I am not wrong) appears to indicate their partial and transitory scope for the elaboration of the reproductive germs. Besides which Rabenhorst, in his work on the 'Freshwater Diatoms,' noticed in 1853 a *Melosira* with sporangial frustules, from one of which, from a lateral aperture, he witnessed the escape of the germs, an occurrence of which he gives a figure in pl. x. In the Sixth Volume of the 'Quart. Journ. Mic. Sci.' it is stated that, at the meeting of the Dublin Natural History Society on the 7th of May, 1858, the excellent microscopist Mr. O'Meara read an account of a circumstance which he had for the first time observed some days before in a recent gathering containing *Pleurosigma Spencerii*. In these diatoms the endochrome, instead of the usual colour, was of a beautiful green, with scattered granules of a bluish green. These individuals were seen to move with sudden starts to the lower part of the vessel, until first one or two, then others, and at last seven or eight individuals, at some distance from the diatoms, were seen to be furnished at the extremity with vibratile cilia moving with great activity. On the following day the appearance of the frustules was changed, inasmuch as but few granules were visible, and the colour of the endochrome had become olive green, whilst, instead of being disposed across the cell, it appeared collected in narrow bands along the two sides of the valves.

These two observations of Rabenhorst and of O'Meara conclusively prove the formation of the germs of the Diatomaceæ in the sporangial frustules, and their exit from the interior of the cell. Moreover, other instances have been noticed in which numerous minute diatoms have been observed within a cyst, a circumstance which was recorded by Mr. Smith in April, 1852, in a gathering of *Cocconema cistula*, in which instance he remarked the perfect resemblance between the included frustules and the surrounding ones, amongst which some of the most minute, both of those contained in the cysts and the rest, presented every gradation in dimension up to those of the adult form and in the state of conjugation. Similar cysts were observed in October, 1851, by Mr. Christopher Johnson, in a gathering of *Synedra*

radians, and by Smith in November of 1853 in the same species; and I had myself an opportunity of making the same observation in the spring of 1856 in a gathering of *Cocconeis placentula* made near Palazzuolo, under the aqueduct of the Fountain of Albano.

But it appears to me impossible longer to entertain any doubt as to the reproduction of the Diatomaceæ by germs after the observations which I have been able to make during the months of February and March last (1868). With the view of studying the development of these organisms I commenced by exposing to the light a cup of water of Trevi, in which on the 10th of February I had immersed a small piece of a green pellicle, which was picked by the point of a lancet from a small mass of refuse. This little *aquarium*, covered with a piece of glass and exposed in the window, at the end of a few days presented a beautiful vegetation of minute green masses, many of which rested on the bottom of the *aquarium*, whilst others coated its sides, and some were seen floating on the surface. On the 26th of February one of the minute floating masses was subjected to microscopic observation under a thin glass cover. It exhibited an innumerable multitude of beautiful green spherical spores, inclosed in a granular substance, in which might be perceived some nuclei or rounded corpuscles of a bluish or glaucous green colour. All the spores did not present the apparently uniformly granular contents, many exhibiting, together with a gradual disappearance of the granular aspect, some in more and some in less degree, a disposition to become organized into various distinct masses, with such gradations as to show the identity of nature between the granular spores and the very numerous hyaline cysts which were visible in the same mass. These cysts included two, three, or more navicular forms, furnished with a glaucous green endochrome and with two large vesicles, probably oily from their strongly refractive aspect. It was impossible to entertain any doubt as to these bodies being diatoms, for, having slightly moved the covering-glass, some of the cysts were ruptured, and allowed the escape of the navicular corpuscles, which, as they were carried away by the current, exhibited alternately the elliptical *side* and rectangular *front* of the frustules. Besides this some valves were noticed deprived of their endochrome, which, when attentively examined, plainly showed the usual median line and central nodule.

Amongst the numerous hyaline cysts in a state of quiescence enclosing diatoms I noticed two which exhibited a gyrating motion, which was at first extremely active, and

gradually became slower, and at last scarcely apparent. Some minute floating corpuscles in proximity to these active cysts were suddenly attracted, as it were, into a vortex whence I concluded that the movement of the two cysts in question was due to vibratile *cilia*. In fact, I discovered two excessively delicate *cilia* in both of the cysts, disposed in opposite directions, in the most lively motion, and longer than the diameter of the cyst, which, from the presence of these appendages, was proved to be a true zoospore.

I have since omitted no opportunity of making further observations respecting the circumstances accompanying the production of the *Diatomaceæ*, being persuaded that, from an exact knowledge of these conditions, we may probably be able to deduce laws serving to fix the limits of the species at present so uncertain, by distinguishing in the various forms of the diatoms the true diagnostic characters from the variations, affording either temporary indications of the age of the individual or abnormally arising from a monstrous production determined by accidental circumstances, amongst which may be enumerated the place of birth and the development of the diatom. Among the different observations I have made, and the peculiarities I have noticed, I would relate that, having placed another of the little green masses, taken from the same *aquarium*, in an apparatus in which an object could be retained in water for many days without being disturbed, after some time the glass with which the preparation was covered began to exhibit a considerable extent of surface sprinkled over with extremely minute green corpuscles. Some of these appeared as round points, whilst others were slightly oval, amongst which the smallest appeared to be composed of a green substance, whilst others, of larger size and more developed, presented the aspect of an oval cell enclosing two distinct masses, and the largest exhibited no difference from a very small *Navicula*.

These observations respecting the reproduction of diatoms from isolated germs is in no way opposed to the endogenous mode above referred to, according to which they are organized within a cyst, since the different mode of reproduction might indicate specific differences, and in any case the occurrence of such apparent anomalies in the reproduction of the lowest members of the vegetable kingdom is familiar to any one engaged in their study.

A more constant character, that I have observed on every occasion in which I have noticed diatoms in the nascent or young condition, is the peculiar colour of the endochrome.

This colour, from the bright green hue of chlorophyll, passes into a glaucous or bluish-green, olive-green, and yellow, until it assumes the rusty yellow or ochraceous tint belonging to the endrochrome of the perfect or adult diatom. This observation of mine accords with a circumstance noticed by Mr. O'Meara in *Pleurosigma Spencerii*, which at the moment of emitting the germs exhibited a green colour, which, on the following day, had become olivaceous. This seems to me confirmatory of the view that the endochrome of the Diatomaceæ is composed of chlorophyll, which takes on the ferrugineous yellow or ochraceous colour in proportion as it assimilates iron, the presence of which metal in the Diatomaceæ has been proved by the analyses conducted by Professor Frankland at Manchester. And the identity thus proved of the endochrome of the diatoms with chlorophyll affords a further insuperable argument in favour of their vegetable nature.

After these observations I was further desirous of subjecting to the action of nitric acid some of the green masses in the *aquarium* above mentioned, and which I judged to contain nascent diatoms, with the view of proving the presence of silica in them, and possibly of determining the period at which that mineral element is developed. I conducted the experiment with the utmost care I could bestow, so as, in the repeated necessary washings, I might lose as little as possible of these delicate corpuscles. From the minute traces of siliceous matter thus procured as the ultimate product I mounted a preparation in Canada balsam; and although the embryonal forms had been inevitably lost, I was able clearly to distinguish, though unusually small, *Nitzschia minutissima*, *linearis*, and *amphioxys*, *Pinnularia radians*, and an *Amphora*. But in order to discern these I was obliged to employ an oblique illumination, to which was adapted an excellent objective No. 10, with correction for immersion, by Hartnach. In the same preparation, besides others of difficultly recognisable forms, were some of extreme minuteness, in which I was unable to distinguish any details on the surface of the valves; and others, again, which I was able to determine, are of such astounding minuteness as I have hitherto never witnessed in all the numerous circumstances under which I have studied these species.

This would be the place to consider the question whether the frustule, when once formed, is capable of further development or growth, and if new striæ continue to be added to the valves; or if, on the other hand, those already existing may become wider apart, so that in a given space of the

valve a smaller number of *striæ* may be counted. Although my opinion may not agree with that of any one of the most distinguished microscopists, I am at present inclined to the belief that the *Diatomaceæ*, like any other organism which is produced from a germ, is born of small size, and grows as it passes through the various stages of life. And I believe that this growth may take place in various ways in different species. But as an inquiry of this kind is ultimately connected with the very thorny question of the true limits between the genera, species, and varieties of the Diatomaceæ, I will reserve it for a future occasion.

On the Structure *of the* Lachrymal Glands.

By Franz Boll.

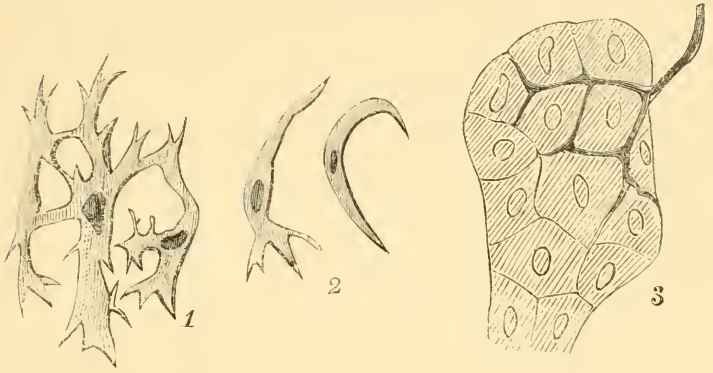
Recently, in histological researches, peculiar star-shaped cells have been noticed in the aciniferous glands. Krause was the first man who isolated these, in the case of the *parotid* of a cat, by means of maceration in vinegar. He is inclined to treat them as nervous organs. Henle also describes stellate cells in the walls of the rennet glands, as well as the parotid and mammæ. He also thinks that they are most likely of a nervous character, although he has never seen any connection with the nerve-fibres. Pflueger describes multipolar cells in the salivary glands of the rabbit. He holds them to be multipolar ganglion-cells, and observed on one side their connection with the fibres, and on the other side with the secretory epithelial cells. Finally, Kölliker has made closer researches concerning the cells in question in the salivary glands. He considers them to be simply forms of the covering structure of the alveolus, which seem to him to represent a kind of reticulum.

I began to give my attention to these doubtful objects whilst examining the lachrymal glands in the summer vacation of 1867, and continued in Bonn later on to do so.

The lachrymal glands of the pig, sheep, calf, and dog, also the submaxillary of the rabbit, calf, and dog, and the parotid of the cat and rabbit, served me as objects of examination. The following are the methods of isolating these cells:—Maceration in vinegar (Krause); treatment with bichromate of potash (Henle); with 33 per cent. liquor potassæ (Pflueger); and placing in a solution of iodine, later on

by twenty-four hours in chromic acid $\frac{1}{3\,0}$ per cent., and bichromate of potash $\frac{1}{1\,0}$ per cent. (Pflueger). I have found the last two methods of Pflueger the most useful, and all the results laid down herein are obtained by this process. If the glands are examined by any other method but maceration the star-like cells are only partly, or not all, seen.

What now appears in the preparation by means of maceration in a solution of iodine is the peculiar form of epithelium, the cells of which swim about in the liquid, either singly or two or three together. I must agree with Pflueger, as against Gianuzzi, that they all show a distinct nucleus. Also, the cell itself is very rarely simply round or polygonal, but mostly breaks out into one or more projections. The projecting forms are peculiary numerous.



Besides the epithelium here noted, all other glands that I have examined by this method have shown the star-like cells, so that I must note it as being a constant appearance. These cells show generally a granular nucleus without nucleoli, which comes out more clearly by the addition of acetic acid. The cell-substance is not true granular protoplasma, but appears to be more homogeneous, soft, pale, and shows a feeble but clear striping in the direction of the outshooting projections. Only in the substance immediately surrounding the nucleus can a fine granulation be seen. The delicate, nearly transparent, smooth projections show the longitudinal striæ the most clearly. The form and size of the real cell-body, the number of projections, and their more or less secondary division and branching, present numerous variations. I only need draw attention to fig. 2, where different forms are represented from the lacrhymal gland of a calf. The species of animal in which they are found also gives

rise to differences. Thus, for instance, in the glands of the calf the cells have large dimensions, and a distinct, richly developed cell-substance. The projections become prominent by gradual contraction of the cell-body, and branch very numerously, generally at a very acute angle. The cells of the rabbit and dog are very thin and small; the processes, which project sharply from the cell-body, branch much less. Between these two forms stand the isolated cells of the lachrymal glands of the sheep.

If, now, we trace these interesting cells by means of the above method (best in the lachrymal glands of the calf), we soon find that they do not present themselves alone, but form singular nets, with tree-like branched tendrils and complicated anastomoses; it may even so happen that we obtain one of these networks which still retains the form of the alveolus, like a basket in which the acinus of the gland lies. The epithelial cells adhere to the spaces in the net which open from the periphery into the hollow enclosed by the network, as by a "scaffolding" (fig. 1). By the inner connection of the surrounding cell-basket with the secreting cells of the alveolus, it often seems as though two kinds of cells were in direct connection. On the other hand the branched cells of the first can easily be mistaken for those of the alveolus—for instance, in such a case as where one or more of the processes are knocked off.

The radiate and much branched tendrils of the cells are, as already shown, smooth and band-like. In the rabbit and sheep the cells themselves are so. In the glands of the calf, and particularly in those of the dog, the parts of the net where the nuclei lie, that is, the cell-bodies, show a distinct thickening. Here we have, according to my idea, a perfectly undeniable explanation of the peculiar formations, which some time ago were described and figured by Giannuzzi from the submaxillaries of the dog, as "möndchen" (lunula). The crescent-shaped forms (fig. 2) are to be obtained in numbers from the lachrymal glands of the calf by means of maceration. They are multipolar cells, which have retained the curve of the alveolus, and are seen in profile, their processes lying in the plane of the profile. If one allows such a form to roll about under the microscope, the transformation of the peculiar crescent form into a multipolar cell takes place under one's eyes. Fig. 2 shows two forms, which appear not unfrequently, where one or more processes are disposed about the crescent, and, coming out of the profile-plane, become visible. If this explanation is adopted the want of the lunulæ in the submaxillaries of the rabbit, where both Pflueger and Kölliker

missed them, is of no consequence. The special thinness of the multipolar cells in the rabbit does not allow the profile view to appear as a half-moon; but yet in these glands the peculiar net-like structure is found, although not nearly so strongly developed as in the calf.

All the above-named glands were examined also as to their nerve-endings by means of the capital method of Pflueger, that is, by the use of very diluted chromic acid. Concerning this method, I need only to mention the writing of Pflueger, and again repeat the advice not to overlook any of the precautions given by him.

In the preparations kept by means of this method the cells which lie close to one another *within* the alveolus appear irregularly polygonal, and, as Pflueger says, nearly of the same size. If not at first sight, at least by different focussing, all show sometimes a simply round, but generally an excentrically placed nucleus, which often sends out a pointed projection. We see no trace of the multipolar cells, and it is only in the glands of the calf and dog that we see peculiar crescent-shaped forms, which generally are disposed about the blind end of the alveolus.

The alveoli appear to be surrounded by connective tissue. In the rabbit this is scarcest and the fibrils finest, and attaches itself very loosely to the alveoli. In old rabbits it is more mixed with stronger fibrils and elastic tissue, and more solid, and is with difficulty detached from the alveolus. It is the carrier of the blood-vessels and nerves. As a peculiarity of the lachrymal glands of the sheep, I may here mention the enormous abundance of stellate pigment-cells which accompany the nerve-branches.

We will now direct our attention to the examination of the course and endings of the nerve-fibres. I will begin with the lachrymal glands, where the relations are simpler, because one nerve, namely the n. lachrymalis, has the whole care of the glands, whilst in the salivary glands the nerves which rule the secretion are difficult to be seen by naked-eye anatomical preparation.

If one examines quite freshly-prepared n. lachrymalis in a solution of iodine, serum, or chromic acid, it will be found that by far the greater portion of the nerve-fibres (in my opinion four fifths) are medullary nerve-fibres. It is worth remarking that all sizes lie close to one another, from the rudest to the finest. Besides these fibres there are also others. Their diameter is very changeable. They consist of a very soft, very easily burst, connective-tissue-like covering, in which granuli are often to be seen, and of a peculiarly

weak, shining, and finely granulated contents. In the inside of the covering it appears finely granulated, pale, or in some places striped with peculiarly fine longitudinal markings. If, however, it should have burst, as may be the case by a careless placing of the covering-glass, it forms peculiar dark balls and shapes, which are to be distinguished from the characteristic pipe-like forms of the nerve-tubes through their more finely granulated character, and therefore more clouded appearance, as well as through the want of double outline.

It is well known that Pflueger saw that in the salivary glands the nerve-fibres approached the alveolus, entered the same, branched out between the single cells, and at last came into connection with the epithelium. I can only endorse these statements of Pflueger. Some of my figures are taken from the lachrymal glands of the sheep. In some, exactly as in the plates of Pflueger (taf i, 1—4), are to be seen the fibres, already known, which come from the stem of the lachrymal nerve, and enter the blunt end of the alveolus, where they pass into an obscure mass, which is not clearly separated from the neighbouring epithelium. Whilst some of these fibres do not show any further difference, and are, therefore, not to be separated from the common fibres of Remak, as M. Schultze has pictured them from the spleen-nerves of the ox, there are others which have the peculiar property of containing, buried in their inside, two and even four peculiar, shiny, soft fibres, which are certainly to be considered as axis-cylinders. Cases such as Pflueger pictures in table i, figs. 5—9, are comparatively seldom seen in the lachrymal glands of the sheep and calf. Nevertheless, I have twice undoubtedly observed the entrance of a large medullary nerve into the alveolus, and have been able to convince myself of the frequent appearance of these forms in the submaxillaries of the rabbit, which certainly, of all glands, is the best for the study of nerve-endings. Oftener, however, forms are to be seen in the lachrymal glands of the sheep, as in fig. 3, where an undoubted fine medullary nerve enters the alveolus, and branches off amongst the epithelial cells. To follow the continuation of the axis-cylinder, which is enclosed in the fibres of Remak, through the finely granulated mass of the place of entrance, is very difficult, although some of my preparations show undoubtedly a soft fibre which branches out amongst the epithelial cells, but whose connection with the axis-cylinder at the place of entrance is not proved with certainty.

Lastly, I must shortly mention the peculiar organs which

Pflueger discovered, and to which, in the submaxillaries, he has given the name of salivary canals (Speichelröhren). These are clothed with cylinder epithelium, and must by no means be mistaken for the excretory ducts of the salivary glands, which are covered with pavement epithelium. They appear to me to be forms of a very high functional importance, because in the submaxillaries of the rabbit, where, after treatment with 1 per cent. hyperosmic acid, they come out beautifully, they take up a fourth of the volume of the whole gland. That they do not act only as a conducting apparatus, that is, as passages for the secreted saliva, is seen from the fact that some end blindly. By the above mentioned method one can see very plainly, at the end of the cylinder epithelium, when it is turned to the light, a striping, which might be the indication of a fine system of fibres, or fibrillation. "Lachrymal canals" also appear in the lachrymal glands of the animals examined, but by no means in such numbers as the canals in the submaxillaries of the rabbit.

QUARTERLY CHRONICLE OF MICROSCOPICAL SCIENCE.

Kolliker's and Siebold's Zeitschrift fur Wissench. Zoologie. Part II, 1868.

1. "*A Contribution to the Knowledge of the Tæniæ,*" by Johannes Feuereisen, of Dorpal. One plate, forty-five pages.

2. "*Anatomy of the Bed-bug* (*Cimex lectularius,* L.), by Dr. Leonard Landois, of Greifswald.—This is a detailed memoir of nineteen pages, illustrated by two plates, and is a worthy successor to the author's treatises on the anatomy of the Pediculi infesting the human species. The various glands of the insect—salivary, Malpighian, and stink-glands—are carefully described and figured. Dr. Landois has examined especially the secretion of the last. He finds that it crystallizes from an ethereal solution in colourless prisms, and has a powerfully acid reaction. Its chemical formula appears to be $C_{30}H_{28}O_4$. The name Cimicin acid is given to this body.

3. "*On the Tunics which surround the Yelk of the Bird's Egg,*" by W. von Nathusius, of Konigsborn.—This is a memoir of forty-six pages, illustrated by five large plates, and worthy of more detailed notice than we can now give to it.

4. "*On the Genus Cynthia as a Sexual Form of the Mysidian Genus Siriella,*" by Prof. Dr. C. Claus. Four pages, one plate.

5. "*On the Snake-like Amphibians* (*Cæciliæ*) ; *a Contribution to the Anatomical Knowledge of the Amphibia,*" by Prof. Leydig, of Tubingen. Eighteen pages, two plates.

6. "*On Deposits of Tyrosin on Animal Organs,*" by Carl. Voit.—This notice, as explanatory of an appearance not unfrequently met with in ill-preserved preparations of animal tissues, is of some interest, amongst others, to the microscopist.

Some years since specimens of fish which had been kept in weak spirit were sent to Herr Voit to determine the nature of a peculiar deposit upon the surface of the scales, which was so copious as entirely to destroy the value of the specimens.

The deposit in question was composed of a multitude of snow-white globular masses about the size of a pin's head. When viewed under the microscope, the globules were seen to be formed of groups of minute radially disposed needles. They could be easily detached from the scales, and consequently afforded a tolerably pure material for chemical examination. They were very difficultly soluble in cold water, insoluble in alcohol and ether, whilst they were readily dissolved in cold hydrochloric acid and alkalies. From the ammoniacal solution, by evaporation, the characteristic acicular bundles of *tyrosin* were readily procurable. Decomposed by concentrate dnitric acid, they afforded a yellow solution, which on evaporation left a yellow-brown residuum, which when moistened with a solution of caustic soda gave a deep reddish-yellow colour, which became brown on evaporation, and finally black (Scherer's test).

From these and other indications no doubt could be entertained that the crystalline material was *tyrosin,* and further investigation only confirmed this conclusion, and proved the distinction of the deposit in question from *xanthoglobulin* and *leucin.*

Leucin and *tyrosin,* as is well known, occur in many animal organs, even when quite freshly prepared, and the demonstration by Kühne, that albuminous matters can be transformed into these products by the action of the alkaline pancreatic juice, is extremely interesting. Städeler and Frerichs have shown their presence also in the lower animals, and especially in the Crustacea, Arachnida, and Insects. But with respect to fish, they were unable to procure *leucin* and *tyrosin* from the Ray and from several organs of the Dogfish, although a small quantity of *leucin* was procurable from the spleen and pancreas, and some *tyrosin* from the spleen of the latter It is consequently impossible to assign the deposit of *tyrosin* in the preparations above referred to to any pre-existing in the fish.

From many considerations it is obvious that in these and in numerous other cases cited the *tyrosin* is the product of decomposition of the albuminous substances, although it would seem that putrefaction, or an approach to it, is unnecessary to produce the effect, as the author cites an instance of some smoked ham in which the intermuscular substance was studded with innumerable white points, standing in strong contrast with the red flesh, and which had been regarded by the dealer as encysted Trichinæ, but on examination by the author proved to be nothing more than minute deposits of *tyrosin.*

In this case it was indeterminable whether the deposit had being formed during life, or whether it was the product of incipient putrefaction before the smoking. But this seemed to be unlikely, as the ham appeared quite fresh, and tasted and smelt quite sweet. The author is convinced that similar deposits of *tyrosin* will often be met with, and it seems useful to bear the likelihood of such an occurrence in mind when the microscope may be called upon to determine the nature of doubtful appearances in ham or pork.

Max Schultze's Archiv.—Part III has not yet been received in this country.

Bibliotheque Universelle. June.—"*On the Contractile Tissue of Sponges,*" by N. Lieberkühn.—In a recent supplement to his numerous investigations of Sponges, Lieberkühn has paid special attention to the ciliated embryos of the Spongillæ. The ova present a perfectly regular segmentation. They are situated, like the embryos, in lacunæ of the parenchyma of the body. It is there also that the spermatic cells are found. To observe the embryos, Lieberkühn divides the Spongilla into thin sections, which he leaves to soak in water for a day. The embryos, up to the moment when they commence their independent life, remain in the envelope formed by the contractile tissue of the sponge, in which they turn about by means of their ciliary coat. During this period the cavity of the body, which is filled with liquid, is formed. A portion of the spheres of segmentation which have not undergone much modification are crowded together in the posterior part of the body, where they form an opaque mass. The cilia of the embryo are very long, and implanted upon still amorphous sarcode, and not upon true cells. The mass of the embryo properly so called, however, is formed by contractile and nucleated cells, a portion of which enclose siliceous spicules in their interior. This tissue is identical with the contractile parenchyma of the sponge itself.

July.—"*On Inflammation and Suppuration,*" by J. Cohnheim.—The labours of Herr Virchow on connective tissue have inaugurated a new era in histology, in which all authors are agreed in attributing to the stellate corpuscles of this tissue an extreme importance.* Perhaps this importance may have been exaggerated; at any rate, a reaction against the ideas of the school of M. Virchow is beginning to make itself felt. The corpuscles of the pus, on the origin of which anatomists have so much disserted, are considered generally at present, with Herr Virchow, as resulting from the ab-

* See Translation of Franz Boll's paper on the Lachrymal Glands in this number of the Journal.

normal multiplication of the stellate cells of connective tissue. The labours of Herr Cohnheim have, however, conducted him to a very different result. He has assured himself that the colourless corpuscles of the blood, the amæboid movements of which are well known, possess the property of passing through the wall of the capillaries without tearing them. They appear to make themselves a way by the dilatation of "stomata" in the vascular epithelium, or perhaps even they may actively pierce the wall. It is, therefore, right to consider whether there may not exist between the colourless corpuscles of the blood and the corpuscles of pus something more than a simple resemblance of form, and whether they are not actually identical one with another. M. Cohnheim gives his adhesion to the affirmative, and he tests his theory by an ingenious experiment. He impregnates with a coloured substance the amæboid corpuscles of a lymphatic sac in a frog, whose cornea he has previously put into an inflammatory condition by a lesion; then he searches with the microscope, among the globules of the pus of the cornea, for the cells impregnated with the colouring matter. As a matter of fact he finds them there, which appears singularly favorable to his view of the matter. The globules of pus would then be lymphatic corpuscles extravasated from the capillaries, although one cannot affirm that these corpuscles are not capable of multiplying themselves outside of the circulatory system.

Comptes Rendus. May.—"*The Tactile Corpuscles.*"—M. Rouget believes he has demonstrated the actual structure of these bodies, which have so often baffled anatomists. He prepares the tissues by soaking them for some time in acidulated water. He then acts on the specimens with strong nitric acid; this, he says, stains the nerve-fibres, and not the adjacent structures. Preparations made in this way lead him to believe that the nerve-fibres are not simply coiled round the cone-like corpuscle, but absolutely enter its substance, and penetrate it.

We shall shortly notice M. Rouget's observations more fully, since he has recently published them, illustrated by two plates, in the 'Archives de Physiologie,' a publication which we are glad to see has just made its appearance under the distinguished direction of MM. Brown-Séquard, Charcot, and Vulpian.

"*Development of Bacteria.*"—M. Béchamp, in a note, which was read to the Académie on May 4, entered into a long account of the developmental relations of Bacteria and Microzymata. Indeed he considered the latter to be the first stage

of the former. The Microzymata are normally simply minute spherical bodies. In this state they exist normally in the human body. But when the tissues are exposed to the air they grow into chains and become Bacteria. MM. Béchamp and Estor seem to think it a proof of these Bacteria being normal constituents of the body, that they are found in the liver. But after all, what is to prevent any organic germs from reaching the inmost centre of the liver, through the mouth, stomach, and gall-duct?

July.—"*On the Existence of Capillary Arterial Vessels in Insects.* By Jules Künckel.*—Zoologists supposed that the circulation of the blood in insects was limited to certain currents detected by Carus in transparent larvæ, when in 1847 M. Blanchard proved that the tracheæ of these animals fulfilled the function of arteries, by conveying, in a peripheral space, the nutritive fluids to all the organs. He ascertained, by means of delicate injections, the existence of a free space between the two membranes composing the tracheæ: the injected fluid expelled the blood and replaced it.

After having verified and confirmed M. Blanchard's discovery, M. Agassiz insisted upon the evidence of the demonstration. Seeking afterwards to complete this discovery, he paid particular attention to the termination of the tracheæ. In a memoir published in 1849,† this naturalist distinguished the ordinary tracheæ terminating in little ampullæ, and the tracheæ terminated by little tubes destitute of a spiral filament, which he named the *capillaries of the tracheæ*. M. Agassiz expresses himself as follows:—"In the grasshoppers which I injected by the dorsal vessel I found in the legs the muscles elegantly covered with dendritic tufts of these vessels (the capillaries of the tracheæ) all injected with coloured matter; and in a portion of a muscle of the leg of an *Acridium flavovittatum*, submitted to a high magnifying power, I observed the distribution of these little vessels, which has a striking resemblance to the distribution of the blood-vessels in the bodies of the higher animals."

Nearly twenty years have passed since the period when M. Agassiz announced these facts, which appear to have been but little understood; for the authors who have written on the anatomy and physiology of insects have not even mentioned them.

The direct observation of the phenomenon of circulation was wanting; no one had succeeded in detecting the move-

* Translated in the 'Ann. and Mag. Nat. Hist.,' Sept., 1868.

† 'Proc. American Association,' 1849, pp. 140—143; translated in 'Ann. des Sci. Nat.,' 3e sér., xv, pp. 358—362.

ment of the blood either in the peritracheal space or in the capillaries; and M. Milne-Edwards indicated as a fact to be regretted that "the existence of currents in the tubiform lacunæ had not yet been ascertained." Having been led, by general researches upon the organization of the Diptera, to study the apparatus of circulation and respiration, I have frequently examined the tracheæ. I always saw, without difficulty, the globules between the two coats; but, the animals being dead, the blood was motionless. In pursuing my investigations of the distribution of the tracheæ in the muscles, I was too much struck by the character of this distribution not to dwell upon it. Having succeeded in removing a muscular bundle from a living Eristalis, without tearing it, and brought it quickly into the focus of a powerful microscope, I had the surprise of seeing the blood imprisoned between the two membranes of the tracheæ running in this peritracheal space, and penetrating into the finest arterioles. I observed the course of the blood-globules with the same facility as in the capillaries of the mesentery or the membrane uniting the digits of a frog. I was, therefore, fortunate enough to see the circulation of the blood in the capillaries of insects.

I have been able to convince myself of the existence of a system of arterial capillaries in all insects: the most delicate arterioles creep, not only through the muscles, but also over the other organs. In general the blood thus observed by transmitted light presents a rosy tint very favorable for observation. When the blood abandons the trachea and its arterioles, which I have frequently seen, they lose their coloration. The trachea, recognisable by its spiral filament, may always be perceived; but it is very difficult to distinguish the arterioles, so delicate and transparent are their walls.

The difficulties of the experiment are great. The insect must be quickly opened, a muscular bundle must be taken from the living animal, and this bundle conveyed under the microscope; and then, under favorable conditions, the blood is seen flowing rapidly through the arterioles. For these investigations a considerable magnifying power is necessary. I have been singularly aided by the very perfect immersion-objectives which M. Nachet was kind enough to place at my disposal.

It is necessary to give a precise explanation of the structure of the arterioles and their mode of distribution.

The tracheæ, as is well known, are composed of two coats: the inner coat forms the envelope of the aëriferous

canal; the outer coat, or peritracheal membrane (*peritoneal membrane* of the Germans), surrounds the former envelope, leaving an interval, the peritracheal space. But at the point where the tracheæ penetrate between the muscular fibres, the inner coat disappears, and the aëriferous canal terminates cæcally, whilst the outer coat or peritracheal membrane becomes the wall of the blood-vessels or arterial capillaries. It is not only the spiroid thickening of the inner coat, or spiral filament, that disappears, it is the inner coat itself that stops and suddenly closes the aëriferous canal. In this way we see, starting from a more or less voluminous tracheal stem, very delicate blood-vessels, in larger or smaller number, which divide and subdivide regularly to their extremities.

The blood retained in the peritracheal space remains throughout its course in contact with oxygen; it reaches the capillaries perfectly vivified, and is a true arterial blood. The capillaries are not in communication with venous capillaries; the blood diffuses itself through the tissues, nourishes them, and falls into the lacunæ; the lacunar currents convey it again to the dorsal vessel.

Thus, to sum up, the tracheæ of insects, which are aëriferous tubes in their central portion and blood-vessels in their peripheral part, become at their extremities true arterial capillaries.

August.—"*Note on the Microzymata contained in Animal Cells,*" by M. A. Estor.—The author makes additional remarks as to the evolution of Microzymata, or molecular granulations, normally in cells of animals. These Microzymata, in the conditions specified, group themselves two and two, or in still larger numbers; then elongate slowly, at length in such a manner as to represent true Bacteria. These facts are the results obtained from a great number of experiments made on different animals. The following observation shows that the same transformations may take place in man. A cystic growth, cut out three days before, and filled with a half-liquid, greenish matter, was submitted to a microscopic examination. Microzymata at all periods of development were observed: isolated granulations, others associated, others a little elongated, and lastly true Bacteria.

Robin's Journal de l'Anat. et de la Physiol.—"*Micrographic Society of Paris.*"—The reports given in 'Robin's Journal' of the meetings of this Society are very interesting, and show that a great deal of real work is being done by its members.

M. Balbiani drew attention, at the February meeting, to the tubular prolongations of the nucleolus in certain cells,

which, he said, Lubbock had noticed in the ova of Myriapods, though he had not regarded them as tubes. As to the question of the movements of cells, they are of two sorts—amœboid or movements of reptation, and movements of contraction. These last may be observed in the ovules of Myriapods and of Arachnida. Thus, in the ovule of Phalangium, the central globule possesses several vacuoles, called generally nucleoli by the German authors. The greater part regard them as solid bodies, but La Valette St. George considers them as vacuoles. If one examines one of these ovules without the addition of any liquid, on a preparation closed with wax, one sees one of these vacuoles enlarge. It becomes sufficiently voluminous to be excentric relatively to the nucleus, and to make the surface bulge. It bursts then, and is replaced by a depression, and finally disappears. Several of these vacuoles enlarge and burst successively in the same way, which can be confirmed by looking for two hours at the same preparation. This is very different to movements of reptation. A German botanist, Dr. Cohn, has seen similar vacuoles. M. Mecznikow has observed them in the cells of the salivary glands of insects. It is vacuoles similar to these which communicate with the tubes which M. Balbiani described in various cells.

M. Balbiani has discovered what he considers to be Psorosperms in the Myriapod Geophyllus. This is interesting, as widening the area of habitat of these parasitic growths. M. Balbiani considers the fungoid growths which occur in the Silkworm disease to be Psorosperms. If these bodies, which are clearly vegetable, be identified with the Psorosperms of Fish, then must we be very careful to draw a sharp line between Psorosperms and Pseudonavicells—the bodies which result from the breaking up of the Gregarinæ; for it requires very much more proof than we at present possess to admit the Gregarinæ into the group of half-plants half-animals which has been brought to light by Cienkowski's observations on Monad-forms, and De Bary's on Myxogastres. At present the Gregarinæ are known almost solely in the active animal form.

At the May meeting M. Lionville described corpuscles from serosities of blisters and burns, which are active, and capable of developing movements. They are minute vesicles, with a black central point; others appear as irregular corpuscles. M. Lionville has also detected vibriones in urine taken fresh from its passage. M. Vulpian remarked that the observations of these motile corpuscles in serosities tended very much to lessen the significance of Hallier's

recent observations.* M. Balbiani stated that the epidermic cells of the skin often contain Bacteria, and may thus be the means of introducing them into blisters, pustules, &c.

Miscellaneous.—"*Action of the Poison of Snakes on the Blood.*"—Dr. Halford, of Melbourne, some time since drew attention in this Journal to the remarkable abundance of white corpuscles in the blood of animals killed by snake-bites. Dr. Joseph Jones, of New York, relates some careful experiments on the action of the poison of the American copperhead snake in the 'Medical Record.' Of several cases observed the following appears to have been the most fully studied. The dog lived six days, and directly after being bitten alteration of the red blood-corpuscles was noticed about the wound. A post-mortem examination was made thirty hours after death.

The fore-leg which had been struck by the copperhead was infiltrated by the bloody serum; all the fibrous tissues of the leg and thigh beneath the skin, up to the abdomen and beyond, were greatly infiltrated with dark purplish-black serum. Under the microscope this presented numerous oil-globules and altered blood-corpuscles, with ragged star-like edges; long acicular crystals were also seen floating amongst the altered blood-corpuscles. The blood, from the swollen infiltrated cellular structures of the head and nose, where the snake inflicted the severest bite, presented a peculiar appearance; thousands of small acicular crystals were mingled with the altered blood-corpuscles, and as the bloody serum and effused blood dried, the blood-corpuscles seemed to be transformed into crystalline masses, shooting out into crystals of *hæmatin* in all directions. The blood-vessels of the brain were filled with gelatinous coagulable blood, which presented altered blood-corpuscles and acicular crystals.

The muscular system everywhere presented a dark purplish colour. The heart was filled with coagulated black blood. When spread upon a glass slide, the blood-corpuscles almost immediately commenced to assume a crystalline form. Blood-vessels of brain filled with dark blood; membranes and structures of brain presented a normal appearance; there were no lesions of the brain recognisable to the eye. The exterior fibrous sheath of the spinal cord presented a red appearance, as if the colouring matters of the blood had been effused; structure of spinal cord natural; vertebral arteries filled with coagulated blood.

From this and other cases in which the blood was examined of the living animal, Dr. Jones concludes that the

* Vide Rev. M. J. Berkeley's Address in this number of the Journal.

special toxic effect of the poison of the snake is due to its destructive effects on the red blood-corpuscle.

Mr. Frank Buckland also, in a recent note on this subject, arrives at a similar conclusion. He says that the poison seems to "curdle" the blood.

"*The Microscopical Illumination of Diatoms.*"—A paper read before the Société Philomathique, of Paris, on April 18th, on the above subject, contains one or two points of interest. The author, M. Fréminan, makes the following remarks:—"The ordinary method of examining the Diatomaceæ consists in illuminating the object by means of oblique light, so arranged that the reflected bundle strikes it at an angle of 45°. This method he considers most unsatisfactory. Here, then, are three other ways of illuminating, say Navicula. The *first* consists in passing solar light directly through the object, and protecting the retina by a blackened glass placed over the objective. This mode, he says, gives the striæ very well. The *second* consists in employing the solar spectrum, reflecting from the mirror the light between orange-yellow and greenish-yellow. The *third* consists, whatever may be the magnification, in illuminating the Navicula directly, as opaque objects are illuminated, but by a somewhat different process. We place, says the author, an equilateral prism on the level of the stage, and then we direct a bundle of rays—either white or spectral—between the preparation and the object, and we see the striæ black upon a coloured ground. These processes do not require great experience for their satisfactory employment, but may readily be adopted by the amateur. These methods, says the author, have given me valuable assistance in the examination of Diatomaceæ, and they are equally applicable to other substances. He suggests the following substitute for solar light:—A hemispherical condenser is placed in front of a conical reflector, and a lamp is set between the two. This lamp should be a magnesium lamp, or a lamp in the centre of whose flame a cylinder of solid magnesia has been placed.

British Association.—1. "*On the Homologies and Notation of the Teeth of Mammalia,*" by W. H. Flower, F.R.S. The author stated that he proposed to bring before the meeting an endeavour to ascertain how much of the generally adopted system of classification of the homologies and notation of the teeth of the mammalia, a system mainly owing to the researches of Professor Owen (whose labours in this department of anatomy he gratefully acknowledged), stands the test of renewed investigations, how much seems doubtful and requires further examination before it can be received into

the common stock of scientific knowledge, or how much (if any) is at actual variance with well ascertained facts. One of the most important of the generalisations alluded to is the division of the class mammalia in regard to the times of formation and the succession of their teeth, into two groups; the Monophyodonts, or those that generate a single set of teeth, and the Diphyodonts, or those that generate two sets of teeth; the Monophyodonts including the orders Monotremata, Edentata, and Cetacea, all the rest of the class being Diphyodonts. The teeth of the former group are more simple and uniform in character, not distinctly divisible into sets to which the terms incisor, canine, premolar, and molar, have been applied, and follow no numerical law. The group is, in fact, equivalent to that which the term Homodont has been applied by some authors. On the other hand, in the Mammalian orders with two sets of teeth, these organs are said to acquire fixed individual characters, to receive special denominations, and can be determined from species to species, being equivalent to the Heterodonts. The author then showed that among the Homodonts the nine-handed Armadillo was certainly a Diphyodont, having two complete sets of teeth, and among the Hetorodonts many were partially, and probably some completely, Monophyodonts. Moreover, that almost every intermediate condition between complete Diphyodont and simple Monophyodont dentition existed, citing especially the Sirenia, Elephants, Rodents, and Marsupials. He then, by the aid of diagrams, showed particularly two modes of transition between monophyodont and diphyodont dentition—one in which the number of teeth changed was reduced to a single one on each side of each jaw, as in marsupials, and the other in which the first set of teeth, retaining their full number, were reduced to mere functionless rudiments, and even disappearing before birth, as in the case of the seals, especially the great elephant seal. These observations showed that the terms "monophyodont" and "diphyodont," though useful additions to our language as a means of indicating briefly certain physiological conditions, have not, as applied to the mammalian class, precisely the same significance that their author originally attributed to them. The classification and special homologies of the teeth of the heterodont mammals was next discussed. Certain generalisations as to the prevailing number of each kind of teeth in different groups of animals were sustained, but deviations were shown from some of the rules laid down—such as that when the premolars fall short of the typical number, the absent ones are from the fore-part of the series. The general inference was that,

although in the main the system of notation of the mammalian teeth prepared by Professor Owen was a great advance upon any one previously advocated, we must hesitate before adopting it as final and complete in all its details, and need not relax in our endeavour to discover some more certain method of determination.

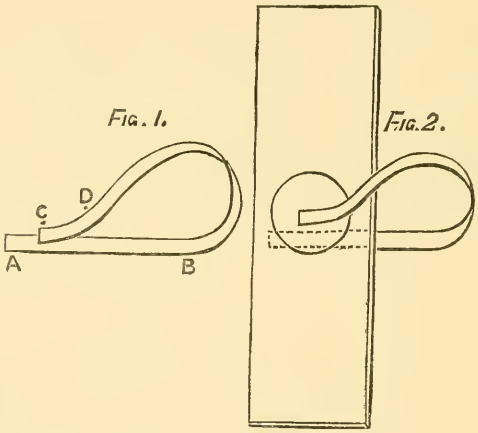
Professor Huxley gave an account of the observations which form the the subject of his paper in this Journal.

Other papers relating to microscopical science were the Rev. A. M. Norman's, on "A New Sponge (Oceanapia) from the Shetlands," and on "*Hyalonema boreale* of Lovén." That by Mr. Moggridge, on the "Muffa," appears in another part of the Journal; whilst the President's (Rev. M. J. Berkeley) Address we have also given in full, since it contains a valuable review of some recent speculations in cryptogamic botany. There was, we regret to state, a very marked absence in the Department of Anatomy and Physiology, of papers on histological subjects.

Medical Meeting at Oxford.—A most interesting and carefully arranged series of preparations, under nearly 120 microscopes, was exhibited by Dr. Lionel Beale at the August meeting of the British Medical Association at Oxford. The series was described in an illustrated catalogue presented to each member, and formed, perhaps, the most complete histological exhibition ever arranged.

Microscopy.—When mounting objects in fluid, I have used for a long time, a simple contrivance, which, as I have seen it nowhere described, and as it is so simple and useful, seems worthy of a note. Its use is for holding the thin glass cover firm, when applying the cement.

I make it of a piece of hoop-spring, about three inches long, heating and bending into a large curve, to approximate the ends, as in Fig. 1. The lower arm, A B, should



be quite straight, and the curve should not project below its level; the end A should project a little beyond the end C, that it may catch under the edge of the slide in applying it. The arm C D should not be quite parallel to the arm A B, but so inclined that when applied to the slide (see Fig. 2) the thickness of the slide will bring them parallel. The arm C D must be quite short, so that it shall not occupy more than half of the thin covering glass. The large curvature allows the cement to be applied quite round the cover. It may be tempered to suit—some stiff, others more flexible. One can be made in five minutes; and, to me, they have proved very useful.—T. F. Allen, M.D., New York.

Heuriscopometer.—Those who study the animalcules, and who make researches among the diatoms or other microscopical shells as a matter of preference, experience great difficulties in exploring a preparation which often contains several millions of these little creatures, each of which has a siliceous carapace, and which have played such an important part in the earth's phenomena of the tertiary epoch. The difficulty is much greater still when it is necessary for them to refind in a considerable number of individuals those which particularly attracted their attention at the time of a first examination. It sometimes happens that, after several hours of research, they cannot attain it, and if patience is not wanting to them, fatigue, at least, obliges them momentarily to relax their labours. Not to refind what one has already seen in a preparation which can scarcely be a centimètre in diameter will doubtless appear extraordinary to those who are strangers to microscopical studies. Whilst the smaller the animals one examines the greater ought the magnifying power of the microscope to be, it is certain that the field of the instrument diminishes in proportion as the extent of the preparation increases. With a magnifying power of 2000 diameters, for instance, a preparation of one centimètre square will attain, then, a superficies of *twenty centimètres on each side.* Every one will comprehend the difficulty of finding in so large a space, of which the field of the microscope occupies but a very small part, the little being which at first attracted attention, whether on account of its peculiar formation, or by certain characteristics indicating in the individual a new species which it is necessary to classify. To obviate this inconvenience several methods have been used. In 1855 Professor T. W. Bailey, of the United States, proposed a universal indicator; it was not really an instrument, for it consisted but of a divided card that was placed on the stage of the microscope, and which offered, as one may suppose, no guarantee for the exactitude of the researches. The one lately indicated by Mr. Wright, in the 'Microscopical Journal,' was not more practical. I sent to the London Universal Exhibition, in 1862, a metal indicator of a very simple construction, depending on a geometrical principle, and being adaptable to all microscopes. It was entered in the general catalogue, No. 1419, in the 13th class. This instrument was very simple; in fact, one of its movements is regulated by a micrometric vice, the other by the fingers only. This indicator, once placed on the stage of the microscope in a fixed and invariable position, the object is refound by the help of the co-ordinates, of which the figures have been written

down. I have just made another indicator, a little more complicated, but on the same principles. It is provided with two grooves, cutting each other at right angles, and moving, one on the top of the other, by the help of micrometric vices. With this instrument, not only do I immediately refind the objects, but I can measure them with a certain precision by means of divided circles placed near to the racked heads of the vices, opposite an index or fixed needle. Each turn of these vices equalling $\frac{1}{4}$th of a millimètre, the circles being divided in a hundred parts, one division corresponds to $\frac{1}{400}$th of a millimètre. With this new indicator I can first explore in full a microscopic preparation, then refind, nearly instantaneously, the object which I desire to examine afresh. To conclude, I can also tell the exact dimensions of the object; I therefore call it the Heuriscopometer. Before finishing this note I ought to say a word about Maltwood's Finder. I have used this instrument several times, and it has rendered me some service. But to substitute photography for the preparation, or the preparation for photography, when one wishes to seek or refind objects, is trouble, and, above all, a loss of time. The shortest way is always the best.—Mouchet, Rochefort-sur-Mer.

[We shall be glad to have a further account of this instrument.—Eds.]

Soiree of the Royal Microscopical Society.—In your report on the Soirée of the Royal Microscopical Society you mention a series of fossil woods as being exhibited by me in illustration of a paper by Mr. Carruthers in the 'Intellectual Observer.' The fossils I exhibited comprised about thirty species of Graptolites (an extinct order of Hydroid Zoophytes), with graptolite germs, &c.; but not a single specimen of fossil wood. The papers by Mr. Carruthers in the 'Intellectual Observer,' and in the 'Geological Magazine,' to which I referred, contain our latest and most accurate information on these interesting fossil zoophytes. — John Hopkinson, 8, Lawn Road, Haverstock Hill.

Cutting Thin Glass.—A correspondent inquires how or with what instrument the thin glass for mounting objects is cut?

Blood-stains.—The ready detection of the presence of blood in a medico-legal case is a matter of importance and interest, and several advances have been made of late years in this

direction. The microscope was found to be of great value, when first introduced, in showing, by the form of the blood-corpuscles, the class of animals whence the blood came; and even now it can hardly be dispensed with, inasmuch as the appearances which it discloses are characteristic, and can be made to last for some time. Further, it introduces no fallacy into the test. A few years later, the discovery of blood-crystals of definite shape and reactions led observers to believe, not only that this was a test more delicate than that which the corpuscles afforded, but that, by noting the different crystalline forms, we might ascertain the animal from which it came, or at least distinguish the blood of man from that of other mammals. Observation, however, proved the incorrectness of this view; and also that, in cases where there was a mere stain, the test was inapplicable. The process, too, was one of by no means easy application.

The next advance was made by examining the blood-solution by means of the spectroscope, and noting the position of the dark bands in the green portion of the spectrum. This process has the advantage of dealing with very minute quantities; but it requires considerable practice and a good deal of scientific knowledge to be certain of the result.

A simpler test, and one easy of application, has been lately devised by Dr. Day, of Geelong. It consists in the addition of tincture of guaiacum and "ozonized ether" to a weak solution of blood, when a bright blue colour is produced. Schönbein, it will be remembered, first described accurately the existence of two differently active states of oxygen, called ozone and antozone. A molecule of oxygen may, in this view, be looked upon as neutral or passive, and formed by the union of a negative and positive particle. Ozone, as is well known, is supposed to be found in atmospheric air, in certain electrical conditions; and it may be produced by passing currents repeatedly through a tube containing oxygen. Some inorganic bodies, as the peroxides of manganese, lead, and potash, contain oxygen in the state of ozone; others, as the peroxides of hydrogen and barium, are supposed to be in an opposite state, and to contain antozone. Ozone has an oxidizing influence on guaiacum resin, and turns it blue, and thus differs from antozone, which has no effect on it. Further, antozonides differ from ozonides, in converting red chromic acid into blue perchromic acid. Van Deen many years ago drew attention to this subject, but Dr. Day has more fully worked it out. See a paper on "Allotropic Oxygen" in the 'Australian Medical Journal,' May, 1867. When tincture of guaiacum is exposed to air or oxygen, it becomes blue; and this change

takes place more or less readily, according as more or less ozone is present. "Ozonides," or bodies containing ozone, have a similar effect. Among organic substances, gum, gluten, and unboiled milk render the resin blue. The reaction with the pulp of the raw potato is well known. Other bodies, as starch, fibrine, boiled milk, and the red colouring matter of the blood, have no such effect. Boiling prevents the development of this blue colour; nor do these bodies recover it when cool. But while neither blood nor antozone, when applied separately, have any bluing action on guaiacum, yet, when they are applied *together*, an intense blue is the result. If a drop of blood be mixed with half an ounce of distilled water, and a drop or two of guaiacum be added, a cloudy precipitate of the resin is thrown down, and the solution has a faint tint, due to the quantity of the tincture used. If now a drop of an ethereal solution of peroxide of hydrogen be added, a blue tint will appear, which will gradually deepen and spread after a few minutes' exposure to the air. This test acts better when very small quantities of blood are used; as otherwise, if the blood is in excess, the solution is red, and gives, with antozone, a purplish or dirty green colour. So minute and delicate is the reaction, that in a case where the microscope failed to identify any blood from a stain in a man's trousers Dr. Day succeeded in obtaining sixty impressions.

Water has the effect of destroying the shape of the blood-corpuscle, and so it cannot sometimes be recognised by the microscope, but it in no way interferes with this new chemical test. Its accuracy may be thus shown. A piece of linen was stained with blood in the year 1840 (Guy's 'Forensic Medicine,' 3rd ed., p. 316); from this a fibre was taken, containing at its extremity a most minute stain of blood; this was placed on a white slab, and treated first with a drop of tincture of guaiacum, and then with a drop of "ozonized ether;" and, although the quantity was so small, and no less than twenty-eight years old, the characteristic blue appeared at once. We have found same result in blood obtained from the urine in a case of hæmaturia, and also in blood drawn from different animals. Dr. Taylor, in 'Guy's Hospital Reports,' has shown that red colouring matters, cochineal, kino, catechu, carmine, &c., exert no such influence; and, as far as it is at present known, no other red stain will produce this result.

Black currants will cause a stain resembling that of blood more than any other; but antozone has no effect upon it.

Ink-stains will cause a blue with guaiacum; so will rust-

stains produced by citric or acetic acid on iron; but then *no* "ozonized ether" need be used, and this at once distinguishes such stains from blood. "Ozonized ether" is a wrong term to use; for it contains antozone, and not ozone, and to this is due its reaction. Ether which contained an ozonide would blue guaiacum resin, whether blood was present or not. The test solution is the ethereal solution of peroxide of hydrogen, which is an antozonide.

The so-called "ozonized essential oils," as oil of turpentine, lavender, &c., really contain antozone; and to this may be ascribed their use in detecting blood; for at first oil of turpentine was used, instead of the peroxide of hydrogen, but the results were unsatisfactory.

If the blood-stain be on dark cloth, the test, as above described, may be used; but then an impression must be taken off on white blotting-paper, otherwise the blue colour will not be visible.

The exact nature of the chemical change that takes place is doubtful; but the test is so simple and easy of application, and, above all, so very delicate, that it is likely to become very generally used. This test fails, as other tests have failed before, to show whether the blood-stain is human or not. The microscope will point out whether a corpuscle comes from a fish, a reptile, or a mammal; but we do not think any microscopist would rely on the mere size of the corpuscle to say whether a cell came from one class of mammals or another, seeing that slight differences in the density of the fluid considerably alter the shape of the corpuscle. When to this delicate chemical test of Dr. Day we shall add one that is decisive as to the derivation of the stain, we shall require no more aids in detecting blood for the purposes of medico-legal investigation.—*British Medical Journal.*

We have received from Mr. W. Andrews a specimen of sponge which he conceives to be *Amphitrema M'Collii* (*Pachymatisma*), Bowerb. "It is," he says, "from the most western land in Europe, Innisveikelane, the western Blasket Island." The swell was too heavy to allow Mr. Andrews to collect some fine specimens he saw. No one else, he observes, has met with this sponge in Ireland but Mr. M'Colli and himself, the former in Roundstone Bay, and the latter on the coast of Kerry. It has never been met with on the south coast, as mentioned by Bowerbank.

PROCEEDINGS OF SOCIETIES.

Dublin Microscopical Club,

16th April, 1868.

Dr. John Barker showed specimens of *Micrasterias fimbriata*, Ralfs, taken near Carrig Mountain, new to Ireland, possessing, besides the ordinary characteristics of this fine species, the additional one furnished by the presence of a number of acute, somewhat curved spines, variously, but seemingly definitely, disposed over the surface. A series of these spines ran in a curve near the base of each segment across its whole width, and a series of similar spines ran close to and parallel with the margin at each side of the end lobe, whilst a few others were disposed here and there (seemingly definitely, though not in rows) over the surface. Inasmuch as no spines, beyond those at the tips of the teeth, thus fringing the margin of the frond, have been mentioned by any writer who records this species (except by Bulnheim, in 'Hedwigia,' ii, p. 21, providing that the form there mentioned be the same as the present), Dr. Barker was inclined to suppose this form may, probably, eventually be regarded as a distinct species, owing to the presence of these spines, notwithstanding the outline and general character of the forms agreed so closely with the published figures. It would, however, be the safer course simply to record this interesting form, leaving it for the future to compare it with foreign specimens, or until both be found conjugated.

Mr. Archer expressed his strong opinion at present that the very pretty form exhibited by Dr. Barker could not be regarded as distinct from *Micrasterias fimbriata*, Ralfs, notwithstanding the presence of the superficial spines, inasmuch as the general form of the cell, and disposition, character, and number of the lobes, agreed so completely with Ralfs' figure, as well as that of Focke in his 'Physiologische Studien,' t. i, fig. 16 (which he showed), which was doubtless the same plant, though there called *Euastrum* [*Micrasterias*] *apiculatum;* but *M. apiculata* (Ehr.), Ralfs, seems to be another plant. No doubt the spines in lines on the surface were a remarkable addition to the characters

appertaining to this species (*M. fimbriata*), and it would almost appear as if these may have been possibly overlooked by previous observers, so identical was the form in other respects with the figures alluded to. A few common species are occasionally found, however, both with and without certain spines, but in regard to which their identity was beyond any doubt. This does not appear to be the plant referred to in 'Hedwigia,' 1866, pp. 58, 59, under the name of *M. fimbriata*, var. *ornata*, Bulnheim, where it is stated that the entire surface is covered by very many spines, and the ultimate divisions of the lobes pass over quite gradually into the spines, without becoming previously rounded off, and that, therefore, the most suitable name would appear to be *M. aculeata;* but whether this is a new species or an equivalent to *M. aculeata*, Ehr., as it possibly is (and which is apparently the same as *M. apiculata*), does not appear.

Mr. Archer exhibited fine and numerous specimens of a minute organism, which appeared to him to appertain to the genus Dinobryon, and to be an undescribed form. This is a rather rare production in our moor pools, and from its generally hyaline character and its minuteness somewhat readily overlooked. That which first strikes the eye is a cluster, occasionally rather dense, of cylindrical (sometimes, when very crowded, somewhat bent), very slender hyaline tubes, disposed in a radiant manner. Each of these tubes is inhabited by a minute monad-like green organism, like that of *Dinobryon sertularia*, but, of course, a good deal narrower and more minute, as the tube in which it dwells is in itself so much less in diameter than the campanulate cells of that species. This monad-like organism is contractile, being sometimes extended up to the terminal aperture of the quill-like tube, and sometimes rather quickly withdrawn into it, though in large clusters with long tubes, it seemed to be permanently placed near the top, the lower portion of the tube being seemingly empty. Very dense clusters sometimes present a rounded outline, those less dense a hemispherical or a fan-shaped form, the tubes appearing distinct to the base, though in a crowded condition, not readily traceable the one from the other all the way down. It would seem that this production must be referred to Dinobryon, though it does not accord with any of the forms already described, though, as Mr. Archer did not know any figures of them, he thought it better to allow it to remain an open question for the present.

Dr. Moore exhibited hairs of a stellate and palmate form from the gamosephalous orange-coloured calyx of *Steriphoma paradoxa*, a Capparidaceous plant from Trinidad, which formed a very pretty object.

Rev. E. O'Meara showed a new Stauroneis from the Seychelles, a description of which will hereafter appear.

Mr. Crowe drew attention to a curious case of malformation in *Closterium striolatum*, consisting in the fusion of two perfect Closteria by their ends, the portion uniting them having become

inflated in a globose manner; at each free end of the so united Closteria there was the usual clear space with moving granules, but at the fused ends there was but one such space, and this occupying the centre of the globose inflation. This *outré* specimen offered a curious example of apparently the same monstrosity which is occasionally seen in various species, especially of Cosmarium and Euastrum, but is seemingly more rare in the present genus.

Mr. Archer observed that no instance similar to that drawn attention to by Mr. Crowe had ever been met with by himself in the genus Closterium, and he knew of but one figure of a similar case, that given by Reinsch in his 'Morphologische Anatomische und Physiologische Fragmente,' pl. ii, fig. 7, which, opportunely enough, he happened to have brought down with him. In that instance, however, the middle or intervening inflation had not become at all so largely expanded as in that drawn attention to by Mr. Crowe. But Reinsch's interpretation of this singularity did not apparently agree with that which Mr. Archer thought to be the true one, for that author seemed to regard this as an instance of normal self-division, and as simply proving that in Closterium this followed the same law as in Cosmarium and other desmidian genera, whereas it appeared to Mr. Archer to be but an instance of abnormal growth, quite comparable to that not uncommon in other genera, where no intervening septum is formed between the new young half-cells, and hence the new and old growth forms but one uninterrupted cavity, the central portion being often distorted and misshapen. So far from this phenomenon, depicted in Reinsch's figure and that of Mr. Crowe, representing normal growth, it is easy to find in a fresh gathering of Closteria many examples of self-division, which accords quite with that of a Cosmarium or Euastrum in essential points, mainly differing, indeed, in the fact that the growth of the new half-cell in Closterium is, for the most part, perfected after separation, in place of remaining attached until the new half-cells (or segments) have acquired nearly or wholly the size and character of the old ones. The phenomenon in Closterium represented in the figure alluded to seemed to be quite the same as that illustrated in other genera (Cosmarium and Staurastrum) by other figures on the same plate (l. c., pl. ii, figs. 4, 5, 6), and well explained at p. 37 (l. c.). It seems evident that, if a double wall is not formed at the very commencement of vegetative growth, there must be then a fusion or soldering together of the segments, just such as Reinsch's Closterium and that now exhibited evince.

Dr. E. Perceval Wright exhibited the spicula *in situ*, and explained the character of certain Corticate sponges met with by him in Seychelles; but as he intends to present the Club with a connected detail of his observations on this group of sponges, it would be premature to enlarge upon them here.

Dr. Dickson exhibited longitudinal sections from the stem of a species of Smilax, showing scalariform ducts, forming a very

pretty object, and thus indicating that scalariform tissue, when found fossilized, should not necessarily be referred to Cryptogams.

Dr. John Barker exhibited a seemingly novel production, but one as yet impossible to determine, even in a general way. This consisted of a large, very broadly elliptic or nearly orbicular, thick-walled cell, densely filled with green contents, having at one or both poles a very slight external depression, and the outer surface minutely and densely pilose all over. On one occasion there was seen springing from one of the depressions of the cell a conical, colourless projection, seemingly of a mucous consistence. No self-division or any mode of growth was seen, and its location or nature seems a problem. This occurred in the same gathering as the *Micrasterias fimbriata*, shown at an earlier period of the evening; and it is to be hoped that another visit to the same source may disclose more of this seemingly simple-looking, but very hard to be determined, production, in order that, if possible, a light might be shed upon its true nature.

21*st May*, 1868.

Dr. John Barker showed a remarkable little parasitic production, growing on the joints of an Œdogonium; this was very minute, balloon-shaped, and containing green contents, the stipes and margin of the inflated portion hyaline, and connected with the interior of the Œdogonium-cell by a little aperture in the side of the latter, whose contents were either partially absorbed and the residue generally effete and brown, or had wholly disappeared. This presented some resemblance to a Chytridium, but would require further examination as to development before its nature could be decided upon; but it formed a curious and singular-looking object.

Mr. Archer presented numerous examples of a very singular-looking encysted state, so to call it, of *Staurastrum cuspidatum*, Bréb. The outer coat or envelope, having always imbedded within it either one or two examples of this species of Staurastrum, was of a definite figure, and with yellowish-green granular contents and a thick wall, and thus the two, one inside the other, presented a somewhat surprising appearance. The most usual form of the outer enclosing cells was that of a depressed or very short prism, the wall rather thick, and the angles somewhat drawn out and thickened into a more or less prominent, colourless tubercle. A variety of forms, however, occurred besides, such as polyhedral, semicircular, &c.; and in all instances the margins thickened more or less, and the angles tuberculated. Inside these cells the contained Staurastrum mostly stood vertically, and when there were two contained they were mostly one above the other in a direct line, often seemingly as just after self-division, inasmuch as the inner segments frequently appeared smaller than

those above and below. In the triangular forms the contained Staurastrum mostly stood with its angles directed towards the angles of the former, with usually but a little space between the ends of the Staurastrum at either end and the inner surface. Not unfrequently, however, this regular position seemed to be disturbed, and this especially in those outer cells of an indefinite figure. When first taken the contained Staurastra seemed to present their ordinary green appearance, but in many of the forms shown this evening they had become more or less brown and dead-looking. One distinct entity thus right in the middle of another, in fact completely invested thereby, and seeming both of vegetable nature, presented a somewhat startling appearance, nor, unfortunately, could as yet any light be thrown on the mystery as to how this phenomenon took place. It is worthy of note that the gathering abounded with multitudes of this species of Staurastrum, with many instances of conjugation, showing the characteristic zygospore of this, in itself, not uncommon species, though not seemingly frequently to be found conjugated. It is, however, not very uncommon to find certain Desmidieæ (especially of the genus Euastrum—for instance, *E. oblongum* or *E. didelta*) completely enclosed in an elliptic or indefinitely shaped coat, which is smooth, without angles or tuberculations, and with colourless granular contents, the included Desmid seemingly always effete and dead. Occasionally one sees more than one (even three or four) enclosed in such a "cyst," or even sometimes two distinct species so included. It is also to be seen in other genera, such as Cosmarium and Staurastrum. Yet, though this phenomenon does not seem to be very uncommon, it is not apparently noticed in any published work. But to say that the more definite and striking form now exhibited seems to be the same kind of thing, is by no means an explanation. The present, indeed, differs in having a definite and marked form, the wall thickened at the angles, and the contents decidedly of a green colour. In fact, *à priori* they might be taken (at first glance, and before one catches sight of the always present Staurastrum) for a distinct form of unicellular algæ appertaining to Nägeli's genus Polyedrium. It may not be here superfluous to observe that this is by no means the same thing as that adverted to by Mr. Archer on a former occasion. (See Club Minutes, 'Microscopical Journal,' Dec., 1866.) The only assumption possible in this case seems to be that they are of a parasitic nature, not living simply upon the surface or inhabiting the interior of the plant attacked, but surrounding and completely investing it. In one instance one of these triangular productions contained, besides the Staurastrum, two half-joints of *Hyalotheca dissillens*, thus pointing to a kind of swallowing up, so to say, of the included algæ (Desmidieæ) during the formation or growth of these singular organisms. A question might arise, Could they possibly be beings of rhizopodous nature, whose food consisted of the Staurastra, and themselves passing through an

encysted condition? That is, could they really be organisms at all comparable, for instance, to Cienkowski's Vampyrella ('Archiv für Mikroskopische Anatomie,' p. 223)? It is very unfortunate that nothing could be communicated of the development of the production now exhibited; but opposed to the foregoing view would seem to be the definite figure, mostly triangular and prismatic, the ribbed margins and swollen angles, and the greenish contents.

Though thus quite unable to throw any light on the curious production now drawn attention to, the thing itself presented so *odd* an appearance, Mr. Archer felt justified in requesting the meeting to look at it, although by no means a gay or attractive object.

Dr. Alex. Dickson showed examples of the curious circumstance of the cells of the root of Neottia filled with the mycelium of a fungus, as described and drawn attention to by Hofmeister. Besides the marvel as to how this parasite obtrudes at all into the cavity of the cells of the orchid, and those not of the superficial layer, but of the stratum immediately under them, it is stated that in all the specimens of this plant in which this production has been sought, it has been found, almost as if it were a part of its nature to be so infested.

Mr. Crowe recorded *Micrasterias fimbriata* from the late gathering made on the occasion of the Club excursion to Tinnehely. This is the second instance of this rare species being found in Ireland, the first being that by Dr. Barker, and that only at last meeting.

Mr. Archer desired to place on record a rather extraordinary example he had met with of that not uncommon kind of malformation seen in Desmidieæ when no septum is formed during new growth, and an abnormal, misshapen, intervening portion becomes interposed between the old segments, the whole forming but one common cavity. A case of this sort in Closterium was brought forward by Mr. Crowe at last meeting. The present instance occurred in *Micrasterias rotata*, and the irregular malformation was carried on to such an exaggerated degree as to present a somewhat grotesque appearance. The old segments were here separated by no less than five intervening, misshapen, irregularly cut, and lobed portions; these marked out by rather deep constrictions from one another, and margined by irregular teeth, and at the two constrictions next to the central one at each side a new growth or malformed segment, so to call it, had grown out vertically to the general plane of the whole structure, which, all taken together, formed but a single unbroken cavity, the cell-contents pervading all the compartments of this singular monstrosity.—Mr. Archer likewise drew attention to a similar malformation in *Xanthidium armatum*, but the new intervening portion of the growth was simply a large orbicular inflation, the noteworthy circumstance being that at the centre of the latter on each front was a single dentate, vertically set process,

characteristic of the genus to which this common and fine form appertains (not two such, as perhaps might be anticipated).

Rev. E. O'Meara exhibited a very curious and interesting new diatom appertaining to the genus Amphiprora, and obtained from the contents of the stomach of a Holothurian from the Seychelle Islands, taken by Dr. E. P. Wright, and it occurred therein not unfrequently. This at first somewhat puzzling form was named by Mr. O'Meara *Amphiprora rimosa*, and described as follows :— Valve constricted; length, ·0070″; greatest breadth, ·0035″; breadth at the constriction, ·0026″. The central line at about three fifths of its length diverges slightly, and, again bending back, proceeds towards the apex; at one end of the valve this divergence takes place towards the right, at the other towards the left; at the point of divergence the line sends out two branches, alternately disposed, and one somewhat longer than the other; the longer branch curves towards the apex, the shorter is straight. Further on, the line forks, one branch, as in the former case, being longer than the other, the longer being also curved towards the apex. The longer and shorter branches are arranged on one side of the line in one portion of the valve, and at the opposite side on the other. Striæ linear, fine, disposed in nearly parallel curves around the extremities of the branches of the central line; the keel is ornamented with a row of moniliform dots. More enlarged description, with illustration, of this fine form, as well as others, are in preparation by Mr. O'Meara, to appear on a future occasion.

Mr. Archer wished to mention having seen the escape of the monad-like body from the encysted condition of *Dinobryon sertularia*. This encysted condition has been described by Hermann (in Rabenhorst's 'Beiträge zur näheren Kenntniss und Verbreitung der Algen,' Heft i), and Mr. Archer had once had an opportunity of showing some specimens at a meeting of the Club; but the escape of the contents seems to be a new fact, so far as it goes. The globose cyst at the mouth of the well-known campanulate carapace of the Dinobryon becomes tilted up, and the monad or zoospore-like body escapes through an opening, which terminates a projection previously pointing into the mouth and towards the bottom of the carapace, which is thus left behind. Numbers of these cysts, empty and separated, others still attached to the carapace, occurred in the water; few colonies remained combined as in the ordinary condition, but were broken up nearly altogether and scattered about in some abundance.

Mr. Archer placed on the table a number of Desmidieæ, showing their zygospores, some of them not hitherto seen in that condition, others rarely so.

The zygospore of *Closterium gracile* (Bréb.) is new, but is very like that of *C. juncidum*, that is, it is orbicular or broadly elliptic and smooth, and placed between the four halves of the pair of mother-cells, which are all pushed asunder by the interposition of the spore. Mr. Archer thought that, although the form and general character of the zygospore in many of the species of Closterium

and Penium agreed, the relative position and arrangement of the parent conjugated cells afforded characters of a certain amount of value.

There was also shown the zygospore of a minute species of Cosmarium, close to *C. bioculatum* on the one hand, and to *C. tinctum* on the other; this is globular and smooth, and quite destitute of spines, and apparently very large in proportion to the dimensions of the parent forms. The segments of this species are elliptic and smooth, constriction deep, end view elliptic. But irrespective of dimensions and general contour giving quite a different impression to the eye, this form is distinguished from *C. bioculatum*, inasmuch as the zygospore of that species has spines. Whilst, indeed, that of *C. tinctum* is without spines, the present plant in itself is a good deal larger, and wants the reddish colour so characteristic in that species. In its smooth zygospore it agrees with *C. pygmæum* (Arch.), but it is quite distinguished therefrom by the elliptic, not sub-quadrilateral, segments. He would name this marked little species now exhibited *Cosmarium tenue*.

Another new zygospore, shown by Mr. Archer, was that of a Cosmarium rather common with us, but rarely found conjugated; but he had taken it at least three times this spring, and from as many distinct sources. This is a form he had not as yet been able to determine, but was desirous to see one or two examples of certain allied Continental forms for that purpose. It is somewhat like *Cosmarium margaritiferum*, but with us more frequently presents itself. Although both may be called common, they do not seem to occur, like some others, in quantities and unmixed with other forms. In fact, it would almost appear as if Ralfs himself may have confused this and *C. margaritiferum* together, judging from his figures. Thus, it may be conjectured that Ralfs' figure ('British Desmidieæ,' pl. xvi, fig. 2 *d*) may represent the present form (the zygospore partially formed only), and that fig. 2 *a* and *b* may be the true *C. margaritiferum*, the zygospore of which is shown at pl. xxxiii, fig. 6 *b*. The present plant can be detected with the greatest readiness, and distinguished from *C. margaritiferum*, under the very lowest power that reveals either, by the semicircular shape of the segments, and by its coarse granules as compared with the much more elegant reniform segments and fine granules of the latter; neither must the present plant be confounded with *C. botrytis*, which is a very different thing indeed. But what would seem to set the matter at rest is the very different zygospore of the form now drawn attention to. The present has an orbicular zygospore covered by not very numerous, but large and pellucid hemispherical tubercles, whilst that *C. margaritiferum* is beset with numerous and elegant forked spines. Nor could it be imagined that the tubercles on the present zygospore were but rudimentary, and might become eventually elongated into spines; for Mr. Archer had now taken this form conjugated at least three times, and from various localities,

and watched it in all stages, and felt quite satisfied that the mature zygospore was now exhibited.

Several other forms rarely found conjugated were also shown, such as *Xanthidium fasciculatum*, *Staurastrum cuspidatum*, *Arthrodesmus convergens* (always with a zygospore without spines), *A. incus*, *Euastrum oblongum*, *E. didelta*, *E. elegans*, *Docidium Ehrenbergii*, and others.

Further, amongst the zygospores shown were those of *Micrasterias rotata* and *M. denticulata*. This latter had not before been met with in Ireland in the conjugated condition. It was pretty abundantly taken on the late Club excursion to Tinnehely. Some of the present examples were, however, from near Carrig Mountain, where Mr. Archer had taken it, associated with *M. rotata*, also conjugated; and he now exhibited examples of both on the same slide. The zygospore of *M. rotata* had not been recorded till he met with it last year sparingly in Wales, and a few weeks subsequently in Co. Wicklow, and here it turned up again along with that queen of zygospores, so far as elegance and size are concerned, that of *M. denticulata*. These are quite unlike, in fact more so than are the forms themselves, abundantly distinct as these are. *M. rotata* has a larger zygospore than *M. denticulata*, and is beset by elongate, simple, subulate, acute spines; whereas, as is well depicted in Ralfs', that of *M. denticulata* is smaller, and beset with shorter, much-branched spines, the branches finally curved downwards. These are, however, scarcely strictly spines, but rather hollow, branched processes, the granular contents from the central general cavity of the spore reaching often a good way up the tube; they are at first fringe-like cylindrical projections, ultimately acquiring thicker walls, and becoming branched. Mr. Archer could not help regarding the very decided differences in the zygospores of these two common species as a conclusive argument for their specific distinctness, for which he had, indeed, on other grounds, long contended.

Mr. Crowe likewise showed examples of the zygospore of *Micrasterias denticulata* taken at Tinnehely.

Dr. John Barker showed examples of the conjugated state of *Closterium lunula*, for the first time seen in Ireland. These were quite in accord with the figures given by De Bary, and described in his work 'Untersuchungen über die Familie der Conjugaten,' p. 48. It would seem not to be quite certain that the figures given by Morren, and called *C. lunula*, do not, some of them at least, apply to *C. Ehrenbergii*, a species quite distinct from the former.

Mr. Archer showed, new to Ireland, *Didymohelix ferruginea* (Griffith, in 'Micrographic Dictionary') = *Gallionella ferruginea*, (Kütz.). This elegant, excessively minute, doubly spiral filament is an excellent test for the higher powers to resolve into its two component helically coiled fibres, though they often occur not intertwined. This plant seems to bear a relationship to Leptothrix comparable to that of Oscillatoria to Spirulina.

Dr. Macalister showed some Fossils from the Lias, believed to be Fish, of which, however, he would make sections, and try to work and exhibit at a future meeting.

Mr. Archer drew attention to a species of Œdogonium undescribed, though it is just possible it may be identical with one alluded to, though not described, in Pringsheim's splendid paper; and though considered here as undescribed, it is again possible that it may be identical with some of Hassal's, though, from the insufficient descriptions, it would be impossible to be certain. The present plant may be thus characterised:

Œdogonium Pringsheimianum (sp. nov.).

Plant monœcious; oospore elliptic, its wall marked by somewhat coarse longitudinal striæ, not filling the cavity of the much larger and elliptic oogonium; aperture of the oogonium very high up, being quite close to the annular striæ of the "caps."

Of Pringsheim's species none are described at once monœcious and elliptic-spored, though in a note he says he knows one such. Can this be the same? Following Pringsheim, now that he has shown us on what characters the true species in the Œdogonieæ seem to depend, it is doubtless better to ignore all old species in this group based merely on relative dimensions of the cells and such like characters, whose value is no more than subordinate.

Mr. Archer further showed fine characteristic specimens of *Œdogonium acrosporum* (De Bary), showing the three-celled, very long, and slender dwarf male, the terminal striate oogonium, without a special wall to the oospore; in fact, every character of this singular species in the most absolute manner, so that there could not be any doubt of the identity of the present plant with that described by De Bary. This species Mr. Archer had once before encountered and exhibited, but it appears rare; and the present specimens were in so nice order, and they are always fugitive, and hence it was well to seize the opportunity of bringing them forward.

Mr. Archer drew attention to a species of Chytridium attacking the oospores of the plant referred to above under the name of *Œdogonium Pringsheimianum*. These occurred mostly in pairs, sometimes one only being present, and were seated upon the oospores, and of an irregular clavate or pyriform figure, tapering off into long necks, which protruded, side by side (or singly), through the aperture in the oogonium, which, as just described for the species, is very high up. From the base of the Chytridium an elongate process or root is sent into the oospore, which is, of course, killed. The zoospores escape by the opened apertures of the neck. It becomes a query whether this may be identical or not with the *Chytridium decipiens* (A. Braun), which also lives upon the spore of an Œdogonium, but for it is described no neck.

Mr. Archer finally drew attention to a new rhizopod, the type of a new genus, which he thought should be thus characterised, and would name it—

Cystophrys (nov. gen.).

Body irregular in figure, without test or integument, possessing, immersed in its substance, a number (often considerable) of spherical cells, each with nucleus, nucleolus, and special wall, their contents increasing by self-fission; pseudopodia slender, and more or less ramified, and occasionally mutually incorporated.

Cystophrys Haeckeliana (nov. sp.). Cells of a bluish tint and granular appearance; nucleus of a sharply bounded, clear, circular outline, and the nucleolus a darkish dot within; cell-wall of a yellowish tint, apparent only when the contents have somewhat receded. Pseudopodia often long, slender, hyaline; branches irregular, their changes of form very slow. Diameter of cells about $\frac{1}{1700}$th of an inch.

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Dr. John Barker again showed the little parasite exhibited at last meeting, in a seemingly more mature condition, in which the cell-contents of the inflated upper portion had become balled together into a spore-like, greenish body, suspended in the centre of the balloon-shaped parasite by means of radiating, linear, pellucid processes, reaching to the inner surface of the pellicular covering; the hyaline stipes and outer investment had become contracted and, so to say, withered-looking.

Dr. Barker likewise showed another minute parasitic structure inhabiting the interior of a number of specimens of *Closterium attenuatum*. These, too, had greenish contents, and were of an elongate form, rounded at ends and somewhat contracted at the middle, and they lay in single or double, or even triple rows, longitudinally disposed, and more or less evenly end to end, though occasionally somewhat irregularly scattered. These had been noticed some weeks ago, and remained up to the present without any perceptible change.

Mr. Archer showed a pretty and well-marked little Staurastrum, seemingly very rare, and now noticed for the first time in Ireland —*Staurastrum arachne*.

Rev. E. O'Meara exhibited a new Navicula, remarkable for its undulate outline; of this, as of other novelties, he is preparing a detailed description and figures.

Dr. Traquair showed scales of Calamiethys.

Mr. Archer recorded the occurrence of *Micrasterias fimbriata* (Ralfs) from Callery, a locality still closer to Dublin than that in which it had been first met with by Dr. Barker. It was singular that this fine species had so long escaped observation here, being shown for the first time only the meeting before last by Dr. Barker, and for the second time at last meeting by Mr. Crowe, and this third instance was from a locality different from either of the other two. The present specimens, Mr. Archer thought, were calculated to bear out his view as to the spines drawn attention to by

Dr. Barker not being of specific value, for the same spines were to be seen here in those now shown, only much more diminished, and in a few they were very scarce or seemingly absent. There could not be a question, however, as to their being quite the same, nor had Mr. Archer any doubt but that the Irish form must be regarded as one and the same thing with that of Ralfs and Focke, so identical were they in outline and figure of the cell, and its lobes and teeth.

Mr. Yeates showed a new Pocket Microscope, recently constructed by him, adapted for high powers, and very manageable; also some nice mounted objects.

NOTICE.

The Editors of the Quarterly Journal of Microscopical Science have received a notice from the Royal Microscopical Society of London, cancelling the agreement which has hitherto existed between them as to the supply of copies of the Journal to the members of the Society, and the admission of the papers read at the Society into the pages of the Journal. Henceforward, therefore, the Fellows of the Royal Microscopical Society will not receive the Journal *gratis*, but should order it through their booksellers. The few pages hitherto taken up by the Society's transactions in the Journal will now be occupied with valuable original articles or translations, whilst any papers of real interest read to the Society will be *fully* reported with illustrations.

The Journal will retain its present form, each quarterly part being illustrated, as before, with lithographic plates and engravings on wood.

The Editors take this opportunity of inviting communications from all engaged in microscopic research in this country and abroad. Besides extended papers, they will be glad to receive short notices, proceedings of Microscopical Clubs and Societies, and to enter into correspondence as to specimens, new apparatus, or other matters relating to Microscopical Science.

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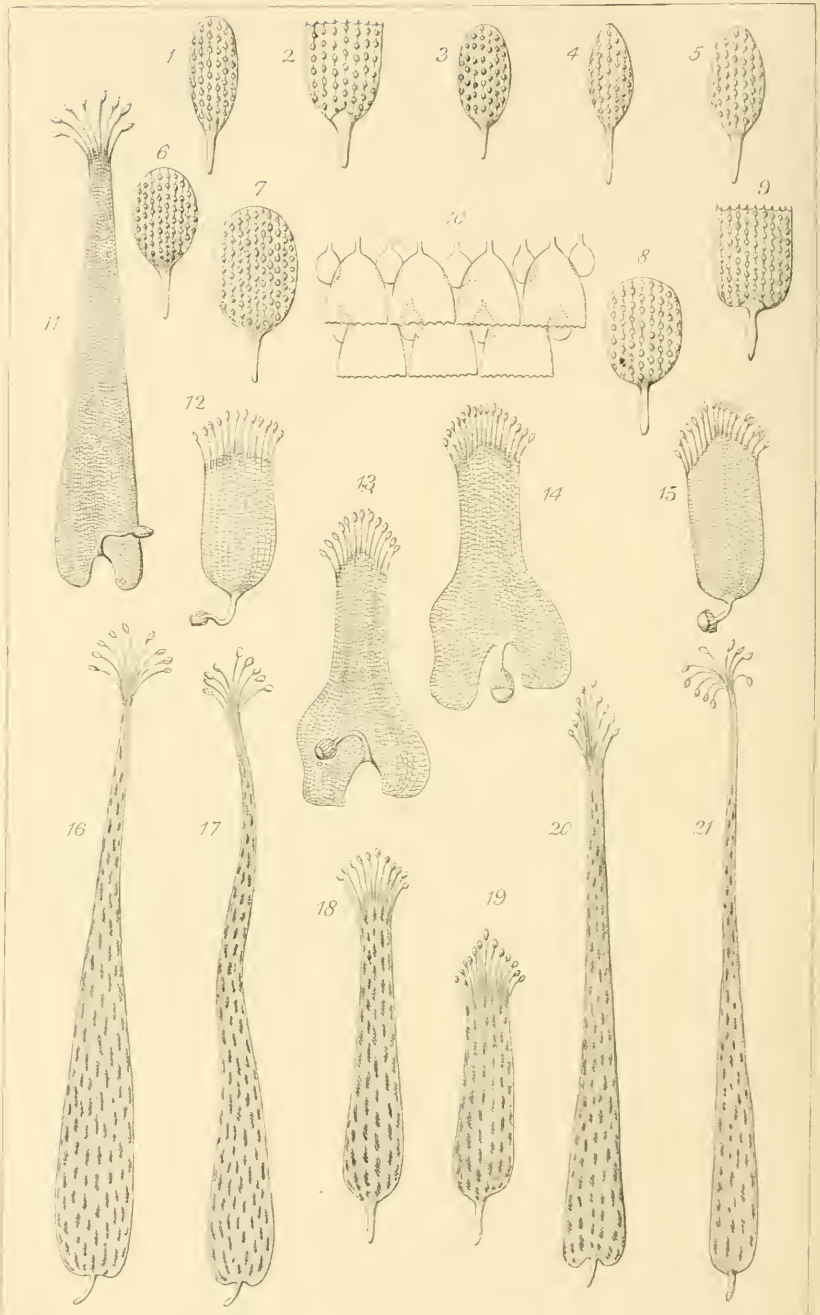


T. W. Wenfer del. T. West

W. West imp.

DESCRIPTION OF PLATE I,

Illustrating Mr. Wonfor's paper on "Certain Butterfly Scales characteristic of Sex."

Fig.

1.—*Polyommatus alexis.* (Common blue.)
2.— „ *argiolus.* (Azure blue.)
3.— „ *acis.* (Mazariue blue.)
4.— „ *corydon.* (Chalk-Hill blue.)
5.— „ *adonis.* (Clifden blue.)
6.— „ *argus.* (Silver-studded blue.)
7.— „ *arion.* (Large blue.)
8.— „ *alsus.* (Little blue.)
9.— „ *batica.* (Tailed, or Brighton blue.)
10.—Relative arrangement of battledore and ordinary scales.
11.—*Pieris brassicæ.* (Large white.)
12.— „ *cardimines.* (Orange tip.)
13.— „ *rapæ.* (Small white.)
14.— „ *napi.* (Green-veined white.)
15.— „ *daplidice.* (Bath white.)
16.—*Hipparchia tithonus.* (Large heath.)
17.— „ *janria.* (Meadow brown.)
18.— „ *semele.* (Grayling.)
19.— „ *pamphilus.* (Small heath.)
20.— „ *megœra.* (Wall argus.)
21.— „ *œgria.* (Wood argus.)

(All, except fig. 10, magnified 240 diameters.)

DESCRIPTION OF PLATE II,

Illustrating the Structure of the Tooth-pulp, and of the Stag-beetle's Auditory Organ (from Max Schultze's 'Archiv').

Fig.

1.—Section through the tooth-pulp of an embryo calf, 30 centim. long, treated with nitric acid, showing the multicaudate odontoblasts.

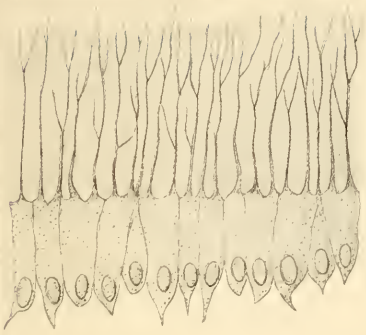
2.—The same, in which the layer of cells has been separated from the "substance" of the dentine.

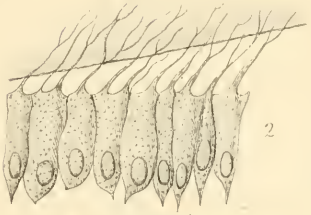
3.—Nerve-endings in the pulp of the incisor of a young rabbit. The processes of the odontoblasts are torn away.

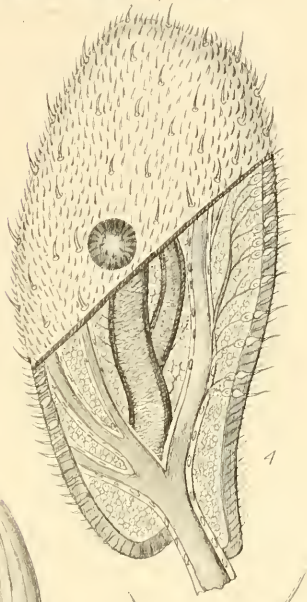
4.—Terminal joint of the antenna of the stag-beetle, partly opened, showing the auditory "pit" and hairs on the surface; the large nerve sending its twigs, one to each hair, the trachean vessels, and the hypodermic tissue.

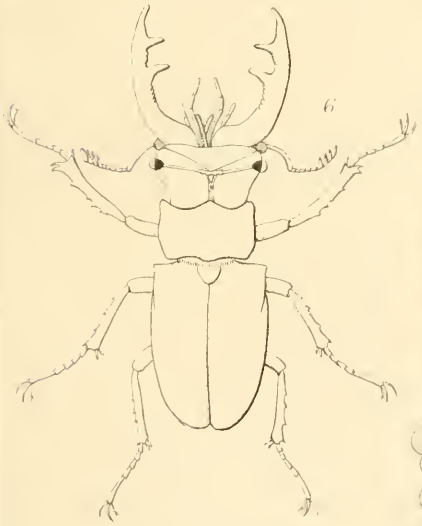
5.—More magnified view of the hairs, showing their connection with the nerves by oval cells; also the two chitin-layers, the superior excavated, and the cellular hypodermis.

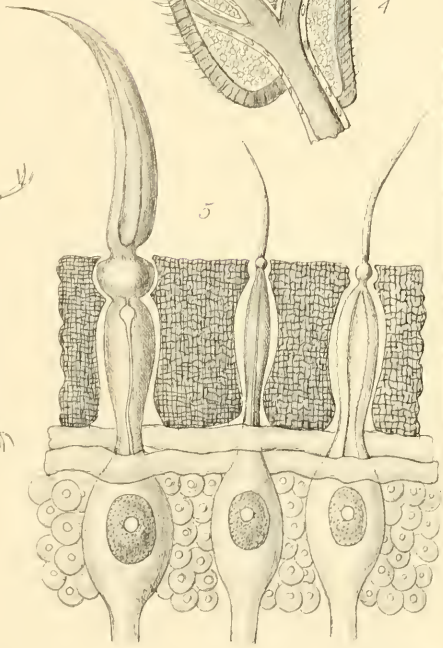
6.—*Lucanus cervus*, drawn in outline to show the origin of the antennary nerve, and the antennæ themselves, with the shoe-shaped terminal joint.

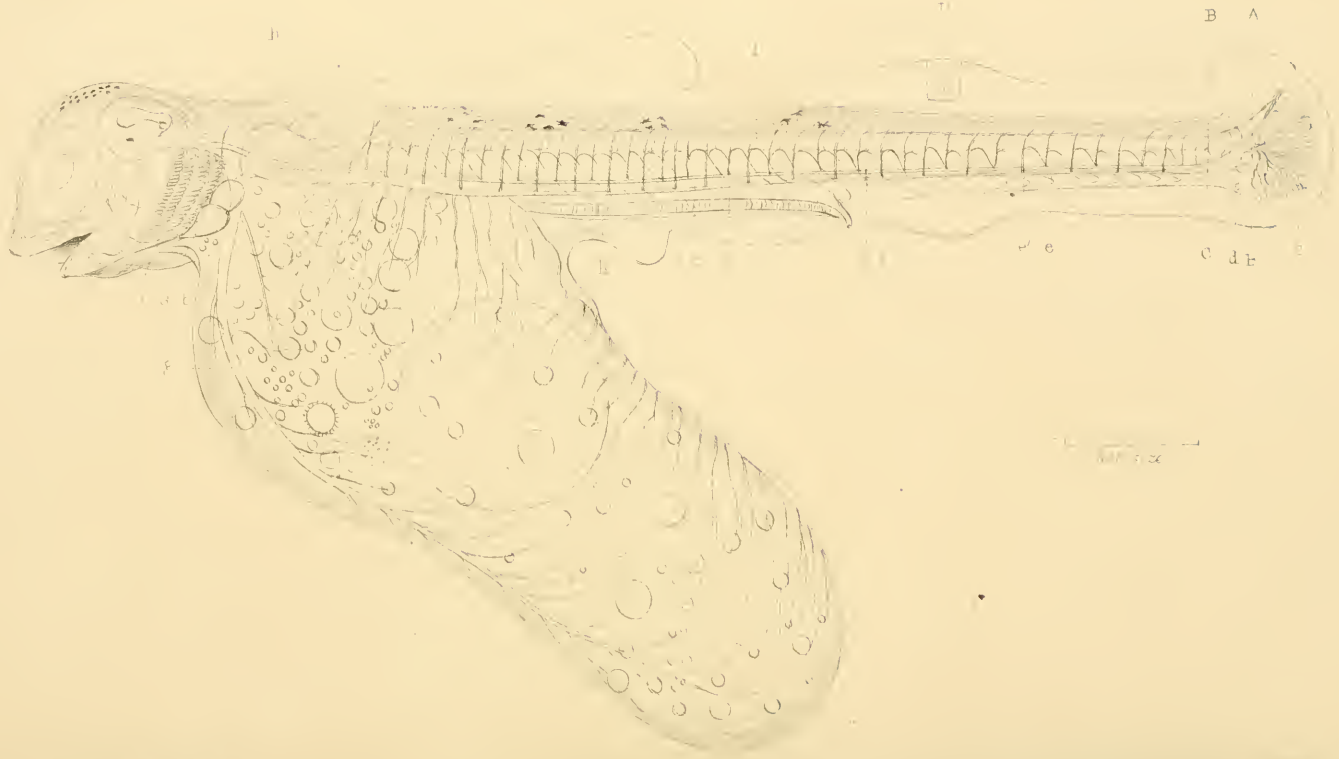








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DESCRIPTION OF PLATE III,

Illustrating Dr. McIntosh's paper on Experiments on Young Salmon.

The figure represents in outline the general structure of a salmon one day old, reduced from a drawing nineteen inches in length.

Fig.

a.—Ventricle.

b.—Auricle.

c.—Caudal capillaries.

d.—Venous dilatation at tail.

e.—Cardinal vein.

e'—Branches of the latter.

f.—Aorta.

f'.—Larger branches of the latter.

f''.—Smaller branches.

g.—Vitelline vein.

h.—Curving vessel of the pectoral fin.

i.—Branchial coils.

k.—Visceral (portal) vein lying beneath the digestive tract.

A B.—Section beyond the chorda.

B C.—Section within the bend of the chorda.

D.—Outline of portion cut from the fatty fin in its early state. The dotted internal lines represent the condition of the parts some hours afterwards.

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δ

DESCRIPTION OF PLATE IV,

Illustrating Prof. Huxley's paper on Organisms from Great Depths in the North Atlantic Ocean

Fig.

1.—Masses of the gelatinous substance.

2.—*Discolithi* from Atlantic mud.

3.— ,, from the chalk of Sussex.

4.—*Cyatholithi* from the Atlantic mud.

5.— ,, from the chalk of Sussex.

6.—Coccospheres of the compact type.

7.— ,, of the loose type.

8.—A crucigerous disk from Atlantic mud.

All the figures are drawn to the same scale, and are supposed to be magnified 1200 diameters.

DESCRIPTION OF PLATES V, VI, & VII,

Illustrating the Rev. Alfred Merle Norman's Notes on British Polyzoa, with Descriptions of New Species.

PLATE V.

Fig.
1.—*Scrupocellaria inermis*, Norman. Front view.
2.— „ „ Back view.
3.— „ „
4.—*Menipea Jeffreysii*, Norman. Natural size of fragment.
5.— „ „ The same magnified, front view.
6.— „ „ „ side view.
7.— „ „ Avicularium more highly magnified.
8.— „ „ Another specimen, showing ovicells and operculum.

PLATE VI.

1.—*Hippothoa expansa*, Norman. Natural size.
2.— „ „ Portion of same, magnified.
3.—*Bugula calathus*, Norman. Natural size.
4.— „ „ Portion magnified, front view.
5.— „ „ „ back view.
6, 7, 8.— „ „ Lateral avicularia.
9.—*Bugula flabellata*, J. V. Thompson. Portion magnified, front view.
10.—*Eschara rosacea*, Busk. Natural size.
11.— „ „ Cells magnified; British specimen.
12.— „ „ Cells of typical Norwegian specimen, from Mr. Busk, to show ovicells.

PLATE VII.

1.—*Eschara quincuncialis*, Norman. Natural size.
2.— „ „ The same, magnified.
3.— „ „ Portion more highly magnified.
4.—*Celleporella lepralioides*, Norman. Natural size.
5.— „ „ Cells of the same, magnified.
6.—*Hemeschara struma*, Norman. Fragment, natural size.
7.— „ „ Cells of same, magnified.
8.— „ „ A cell, more highly magnified.
9.—*Hemeschara sanguinea*, Norman. Fragment, natural size.
10.— „ „ Cells, magnified.
11.— „ „ A cell, more highly magnified.

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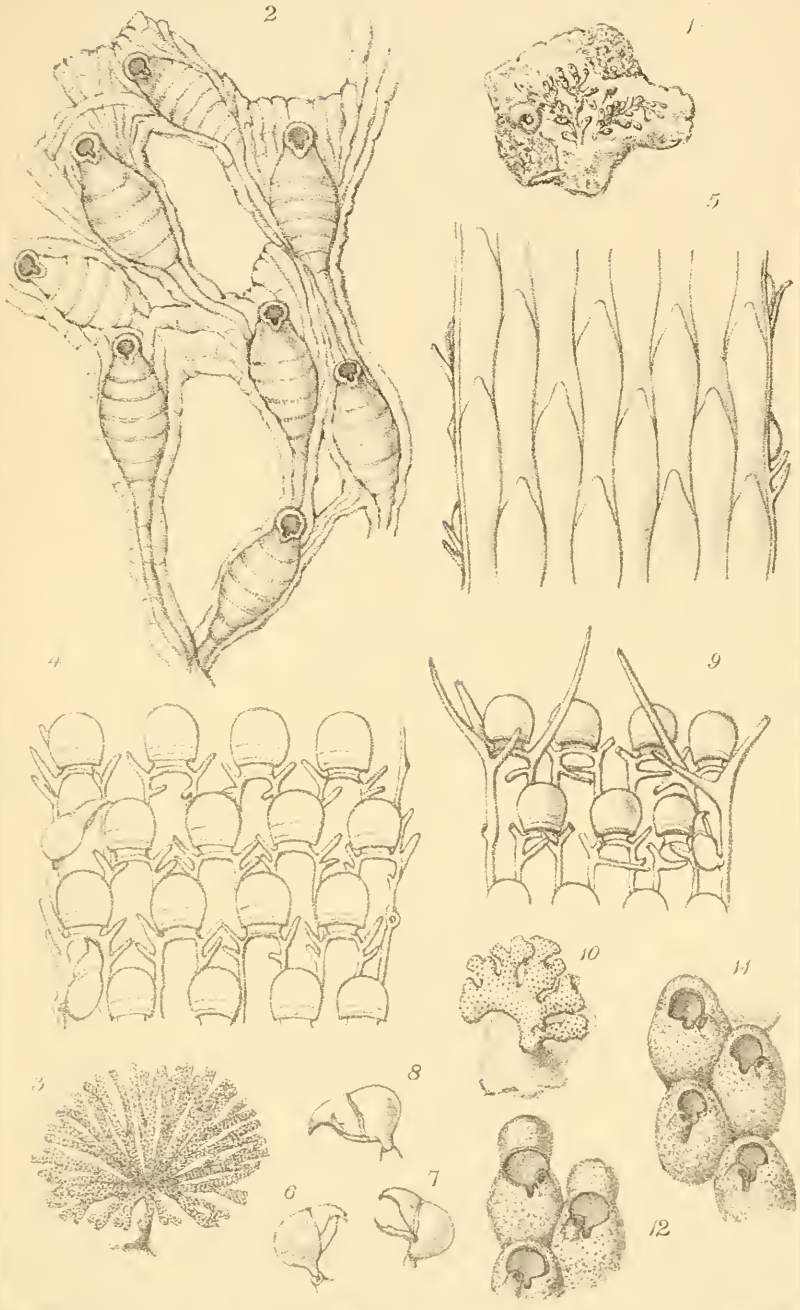
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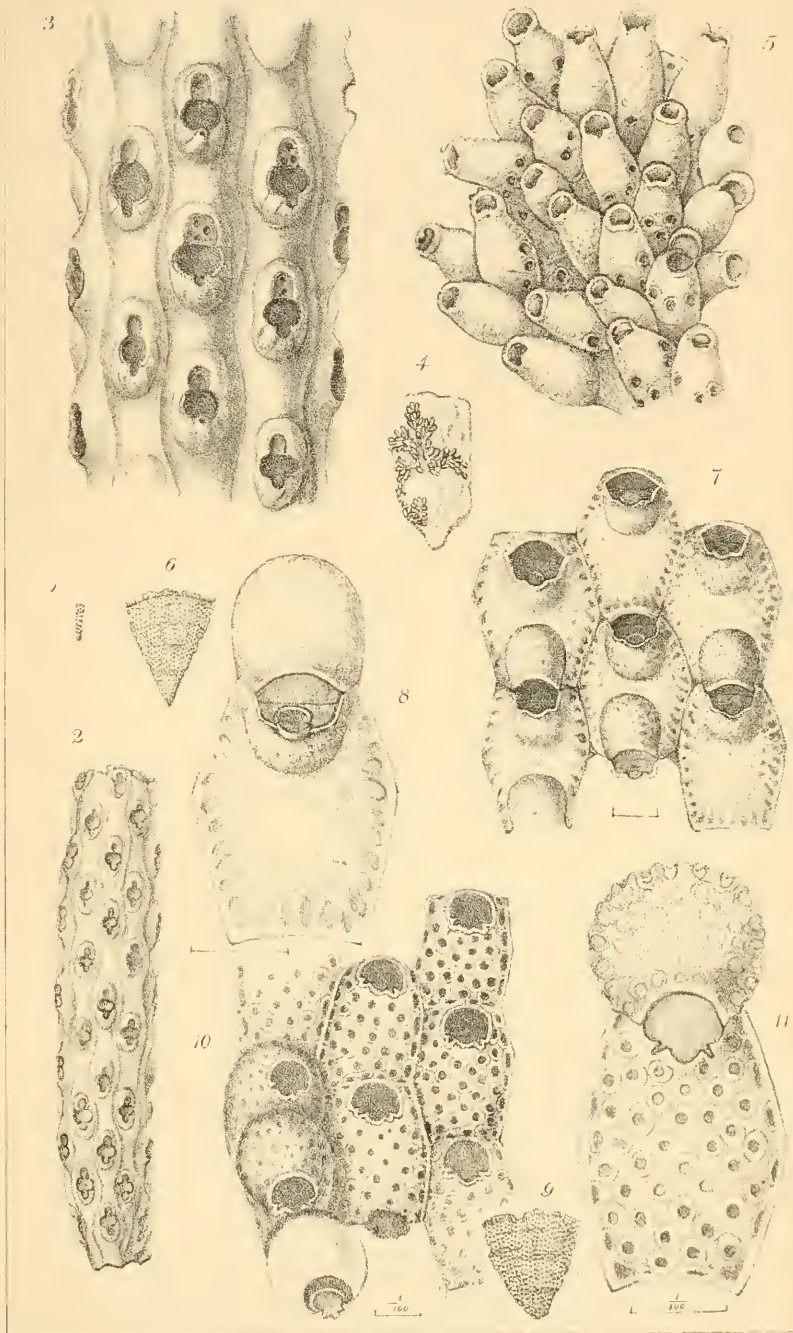

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